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About Authors

● **A. T. Colwell** *(M '30), is credited with much of the successful research and development work done on improved heat-resistant valves and valve-seat inserts, especially for high-duty automobile and aircraft engines. He graduated from West Point as a distinguished cadet in 1918 and spent four years in the Army, during which time he received his C.E. degree from the Engineering School at Fort Humphreys, Va. He then joined the Steel Products Co., which later became Thompson Products, Inc., as junior salesman. He has remained with the company, advancing to vice-president in charge of engineering and was recently made a director of the company. Mr. Colwell served on the SAE Council in 1937-1938, and in 1936 was chairman of the Cleveland Section. He has also been active on several of the Society's technical and administrative committees.*

● **Walter S. Fisher's** *association with the automotive industry dates back to 1909, when he joined the Stoddard-Dayton Motor Car Co. When the company became a part of the U. S. Motor combine, in 1911, he came to New York, later associating with the Edwards Motor Car Co., of that city, formed by former Dayton officials. In 1914 this company was absorbed by the Willys-Overland Co., and Mr. Fisher joined that organization, remaining with it in increasingly important engineering posts until four years ago when he went with the General Motors Truck & Coach Co., in charge of design and development of engines.*

● **Paul Huber** *has worked on noise problems for General Motors since 1932, including muffler and intake silencer design, general car noise, and instrumentation. He was formerly employed by the research laboratories of the Republic Steel Corp. Mr. Huber received his B.A. from Ohio Wesleyan and his M.A. and Ph.D. degrees from Ohio State. He specialized in physics.*

● **Francis Masi's** *work with the aeronautical engine laboratory of the Naval Aircraft Factory, Philadelphia, since 1929,*

(Concluded on page 52)

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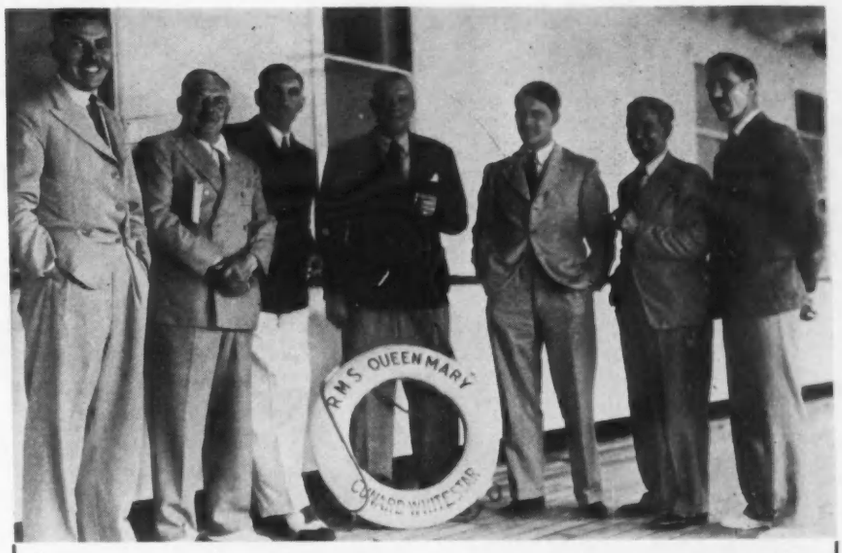
SAE World Automotive Engineering Congress *Stresses*



Engineers from 20 nations took part in the great Congress. This British delegation arrived on the "Queen Mary." It includes (left to right): Raymond N. Dorey, engineer, Rolls-Royce, Ltd.; John W. Howlett, managing director, Wellworthy, Ltd.; L. G. Callingham, Shell Mex. B.P., Ltd.; Harold Andrews, managing director, Harold Andrews Grinding Co., Ltd.; F. L1. Smith, personal assistant to general manager, Rolls-Royce, Ltd.; Benjamin A. Davey, manager, S. U. Carburetor Co., Ltd.; and Ralph H. Street, technical engineer, Shell Corp. of Australia.

Thought Freedom Vital to Best World Technical Progress

THE vast power of group engineering effort when generated by the voluntary cooperation of individually free minds was emphasized over and over again throughout the panorama of sessions, conferences and other activities of the World Automotive Engineering Congress of the Society of Automotive Engineers, which began in New York on May 22 and ended in San Francisco on June 8.

Leaving New York, the Congress reconvened at Indianapolis, went to Detroit for three days, was welcomed for a day in Chicago, took the Santa Fe "Super Chief" to Los Angeles, was entertained there for a few hours, went on to Bakersfield by bus, and there entrained on the streamliner "Golden Gate" to complete the trip to San Francisco. Delegates, members and guests from overseas participated in the events throughout the Congress, more than 20 different nations being represented. From start to finish the Congress was truly international in fact, as well as in spirit and concept.

Officially opening the Congress in New York, President W. J. Davidson made a plea for wider application of the engineering approach to all human problems. "Get the facts," he urged, "and act upon them in the light of the principles established from them." SAE Secretary and General Manager John A. C. Warner, presiding at that same opening session, pointed to the lasting power of results achieved "by the voluntary cooperation of a lot of rugged individualists – men who, of their own free will, decide to pool their efforts."

Photographs at New York by Leslie Peat.

Paul G. Hoffman, toastmaster at the New York dinner, stressed the many free minds – minds that are not subservient – produced in America, adding that "in each generation there are only a very few such minds, but those few are tremendously important." C. F. Kettering said that engineers and management, working cooperatively, will lift us out of the doldrums and make us go ahead. W. J. Cameron voiced the belief that "from engineers and the productive processes they set in motion, emanate the values that endow society with economic steadiness."

Most of the papers presented were based upon data and information developed by many men, each applying his own mental talents freely in a particular field – and more than a few of the papers were actually the composite work of several men. The two papers receiving the Horning and Manly medal awards, respectively, were each written by co-authors – and in both instances those co-authors credited their success to cooperation in the background of scores of fellow automotive technicians.

So grew the theme of this great gathering at which total attendance exceeded 4000 – a theme which appeared to spring spontaneously from the hearts of many speakers without predetermined focus; a theme exemplifying itself in the very manner of its impulsive development.

And at the great closing Congress banquet in San Francisco, the same pulsating fervor for fearlessness of individual thought and effort appeared in the address of the speaker of the eve-

ning, Fred M. Zeder, vice-chairman of the board, Chrysler Corp.

So limitless was the scope of technical ideas expressed and of engineering information conveyed throughout the 41 sessions, that no general summary could be attempted of the new ideas and fresh concepts brought out. Startling developments were described in the realm of passenger cars, airplanes, tractors, motor trucks, diesel engines and every other automotive field. Designers, production men, vehicle users and general executives all found stimulation at one or another of the sessions or in some of the activities involved in the Congress.

The following pages tell the specific things that were said – tell the highlights of the ideas and the arguments which struck sparks throughout the great 18-day Congress – show why the gathering marked a milestone in the history of the Society of Automotive Engineers.

NEW YORK

"IN engineering there is no such thing as nationality," proclaimed C. F. Kettering, speaker at the banquet which marked completion of the New York sessions of the SAE World Congress on Friday, May 26. "Information has no regard for customs officers," he said. "It passes right through. It doesn't make any difference in what country, under what type of government, technical knowledge flows freely."

Mr. Kettering was introduced by Toastmaster Paul G. Hoffman, president, The Studebaker Corp., who emphasized the importance of preserving a political economy favorable to the growth of great and free minds because in all countries the history of the nation is written by the few such minds which appear in every generation. "You can't make people an instrument of government instead of keeping government an instrument of the people without having a throttling effect on thought," Mr. Hoffman averred.

The dinner, whose attendance filled the Cafe Rouge at the Hotel Pennsylvania, was opened by M. C. Horine, chairman, SAE Metropolitan Section who introduced the SAE Vice-Presidents and Councilors and the SAE Past-Presidents who comprised a major part of the speakers' table. Mr. Horine also welcomed to the dinner Lieut. Orville Mohler, pilot, and Lieut. A. S. MacNamara, navigator, who had flown from Los Angeles with invitations from the Mayor of Los Angeles and from SAE Southern California Section Chairman W. E. Powelson, for Congress travelers to visit Los Angeles and see its scenic and industrial sights on their way to the final Congress sessions in San Francisco.

SAE President W. J. Davidson, spoke briefly of the good start the Congress had had in New York and forecast continued success for its activities as it proceeded Westward.

Kettering Speaks

Ranging over his usual wide range of topics, Mr. Kettering pleaded for the research department to be made an integral part of industrial operating organizations; indicated that the engineer, through lack of providing new things to work on, might be responsible for the existing excess of men, money and materials; emphasized the need for continued progress in automobile design; and stressed how little we really know about anything, despite a too general assumption that we really know a great deal.

Interesting excerpts from Mr. Kettering's talk include the following:

"The world of engineering today requires a broader outlook – and a better understanding between the technical side of industry and the commercial and sales divisions. We have depended too much on the law of accident for the full development of the technical branches of our industry."

"We can look back over accomplishments with so much clearer vision than we can look forward to un-accomplishments, that each generation is prone to say: 'We don't see how the people who lived before us got along with the things they had, but we don't see much room for improvement.' "

"You have got to take the average over a large number of years to see whether or not it pays to keep an engineering department going."

"You can always tell how much a fellow knows about a subject by the number of Greek and Latin derivatives he uses

SAE World Congress Group Attends Dedication of Plaque to Beau de Rochas

During the Congress a plaque erected to the memory of Beau de Rochas, French inventor who claimed discovery of the 4-stroke-cycle in 1862, was dedicated at the New York World's Fair, and presented to the Society of Automotive Engineers by the Societe des Ingenieurs de l'Automobile.

A delegation of officers and members of the Society and a French group, representing the SIA and headed by that organization's president, Henri Petit, participated in the event. Dedication ceremonies were opened by M. Garreau-Dombasle, deputy commissioner general of the French Republic at the Fair. SAE President W. J. Davidson accepted the plaque on behalf of the Society.

The bas-relief is a replica of a monument erected by the SIA and presented to the Conservatoire des Arts et Metiers after being dedicated at the 1937 French Motor Show by Albert Lebrun, president of the French Republic.

In the picture, left to right, are Mr. Davidson, Mr. Garreau-Dombasle, Mr. Petit, Pierre L. Morian, Charles B. Brull, and Maurice P. Berger.

SAE Officers and Council Receive Overseas Delegates

After the Opening Session of the Congress in New York, the official delegates of foreign nations and technical societies were formally received by the SAE officers and Council. An informal luncheon followed.

in attempting to explain it and by the number of differential signs he puts in his equations. His knowledge is likely to be in inverse proportion."

"Automobile instruction books are the engineers' alibis. You can always tell how good an engineering department is by the thickness of the instruction book, because the car actually makes its reputation after the instruction book is lost."

"History is made up of troublous times. You read in history books: 'For the next 15 years, the country was very prosperous and the people were happy.' It takes about four lines in a history book to say that. The only time you get real space in history books is when you are having trouble. . . . Today we are just having ordinary times. We are never going to have self-running times."

"We don't know the fundamentals of any of our operations. . . . Only four years ago, we thought we knew everything about hydrogen. Then Dr. Urey at Columbia found out there were three kinds of hydrogens – and that is one of the simplest of the elements. Too much we try to fence ourselves in saying: 'That is about as far as you can go.' . . . There is a tremendous possibility of going ahead."

"The motor car industry is what it is today by virtue of about three different kinds of materials – rubber, the most important; petroleum, which is next; and alloy steel, which is next."

Engineers Manage Industry, Reeves Says

At the opening session of the Congress at the Hotel Pennsylvania, New York, on May 22, SAE President W. J. Davidson, declaring the Congress officially open, said that the world today acts too much on the basis of emotions and not enough on the basis of facts, while Alfred Reeves, vice-president, Automobile Manufacturers Association, the chief speaker, predicted that "the automotive engineer has his greatest work ahead of him."

President Davidson was introduced by SAE Secretary and General Manager John A. C. Warner, who presided at the session. Ralph R. Teetor, SAE National Meetings Committee Chairman, joined President Davidson in welcoming the delegates from 20 overseas countries and expressed his appreciation for the aid of the many individual members of the Society whose joint effort had made possible so successful a gathering. M. C. Horine, chairman, SAE Metropolitan Section, added words of welcome from his Section which had the privilege of being the first hosts to the members and guests at this gathering of automotive technicians from every quarter of the globe.

Mr. Reeves said that the automotive industry has been engineer-managed from its very earliest days. Presidents of many of the leading companies, he pointed out, have been engineers and all have recognized design and efficient production as the starting point for success. Research, he defined as the effective use of "patient" money and stressed the importance of such developments in automotive progress. Illustrating the broad scope of interest necessary to anyone viewing the full play of automotive development, he said "the automobile industry begins at the mines and ends at the hot dog stand."

Mr. Reeves paid tribute to the earlier European pioneers in the automobile industry and acknowledged America's debt to those designers. He emphasized the importance of highway development to the future of the automobile and heralded the great gains that are being made in safety – gains in which the efforts of the Automotive Safety Foundation have played a part. "For seventeen consecutive months," Mr. Reeves said, "we have had a steadily improving situation with respect to highway safety. This is the longest period of unbroken improvement in the Country's history, representing a saving of 9230 lives over the previous 17 months. The reduction in fatal highway accidents for the year 1938 was 19%."

"Engineers," President Davidson emphasized, "are essentially builders" and a keystone of their philosophy is never to tear anything down until they have devised something better to put in its place. The factual approach is important, he said, because "no matter what your emotions may be, the facts remain unchanged." He made a strong plea for use of a sane engineering or factual approach to all of the problems with which the world is faced today.

During a brief business session, a resolution, offered by B. J. Lemon, that the words of greeting spoken by Messrs. Davidson, Horine, Teetor and Warner be made a part of the official records of the proceedings of the Society, was unanimously adopted.

Following this session, the official delegates from foreign countries and technical societies were formally received by the officers and Council of the SAE as a prelude to an informal luncheon.

Ford Executive Shows Machine's Aid to Man

"The machine is not a burden but a creative force," urged W. J. Cameron, Ford Motor Co., speaking before the Tuesday evening General Session in New York. He went on to say that the engineer, whose genius made possible the highly efficient industry of today, is an eminently "constructive and stabilizing factor" in a universe of political and economic unrest.

Industry has borne, and still bears, the brunt of malicious attacks, said Mr. Cameron, by groups who continue to view the Machine Age with alarm – by individuals who cannot adjust themselves to the rapid progress of invention.

The arguments of these groups, he declared, boil down to two specific issues, namely, that machines bring about a materialistic civilization and that machines upset economic balance by causing widespread unemployment.

In answer to the first issue, Mr. Cameron replied: "We have no machine civilization but a civilization-made machine." Industry is not an outside force exerting abnormal pressures on man, the speaker said, but rather an inspirational spark within him that demands accomplishment. It is that spark of inspiration, Mr. Cameron pointed out, that will keep industry always above the purely material.

"Material-mindedness is caused by material want, and rectified by material plenty," Mr. Cameron said, "the machine has released man into a higher realm where he was meant to live and where he will live."

Perhaps the most persistent charge brought against industry, Mr. Cameron said, is that machines reduce employment. This charge is based on snap judgment rather than on sound reasoning, he stated, because a careful analysis of the facts reveals the erroneousness of the statement.

Quoting governmental statistics the speaker showed that during those years when mechanization held full sway employment increased more than population. He then pointed out that the workman, who is most directly affected by the conditions, seldom blames the machine for lack of work.

Rather than being a wrecker of economic balance, the machine is a great stabilizer, Mr. Cameron said, for it creates a countless number of auxiliary jobs never possible before its advent.

Opponents of mechanization direct most of their arguments at the industrial machine, the instrument that manufactures articles so rapidly that no amount of hand labor could possibly compete with it. But, the speaker pointed out, they lose sight of the fact that the industrial machine is used principally to produce other machines such as automobiles, typewriters, telephones, etc., which create millions of extra jobs, and whose existence would be impossible without such elaborate mechanization.

To illustrate his point further, Mr. Cameron declared that a hand-made car would cost $17,850. Such an automobile would never create the present industry which employs 6,000,000 men. Thus machines are not only "labor saving but labor serving," Mr. Cameron said, because bringing low cost and quality to the market automatically raises the standards of living for the worker. With the advent of machines, wages increased 112%, he declared.

It was Mr. Cameron's belief that there would be no period of "dislocation" in the future. "Dislocation" the speaker described as being the critical era when people are trying to adjust themselves to change. This condition occurred with the inception of the Machine Age because workers were not keyed to the tempo of advancement. The sudden change was a shock from which some never recovered.

But workers in the future will not be shaken by such periods of "dislocation," Mr. Cameron forecasted, because the generations of today are geared to the forward march of invention.

The meeting was presided over by B. B. Bachman of the Autocar Co.

Passenger Car Sessions

Chairmen

J. C. Zeder **J. G. Wood**

How and why European and American passenger cars differ was the subject of a frank interchange of data between overseas and domestic automotive engineers in the Passenger-Car Sessions. In the first, the frameless car construction widely used in Europe was scrutinized critically to find out whether it is feasible to adopt in this Country, and the principles of "hydrodynamic" power transmission were explained – its advantages and disadvantages aligned. In a second session, surprising data on the performance of European experimental small cars were revealed, and fresh information on the behavior of tires in steering from three test sources was disclosed.

Some Aspects of Frameless Car Design **– W. D. APPEL, General Motors Overseas Operations.**

ASSOCIATED with a company which builds cars of both the frameless and the conventional types, Mr. Appel defined a frameless car as one in which the body is used as a structural member and in which the axles, engine and steering gear are attached to the body, instead of having that unit used merely as a shell for passengers.

The chief differences between frameless and conventional cars, Mr. Appel summed up by saying that frameless cars: 1. weigh about 2% less, 2. cost less by somewhat more than 2% – where sufficient quantities are involved; 3. are definitely more rigid; 4. are necessary to obtain the lowest floor height; 5. cost no more to service; 6. are just as quiet on the road; and 7. do not involve higher insurance rates than conventional cars.

In arriving at these general conclusions, Mr. Appel qualified them in many respects throughout his analysis. For example, he said: "Each time the designer goes to work on a new frameless car he eliminates weight not only by the use of this construction, but also by all other known methods such as increasing stresses, simplifying construction and eliminat-

In Two Parts

THE activities of the World Automotive Engineering Congress were conducted on a transcontinental basis.

What happened in each city is told in the two sections of this issue of the SAE Journal. Here in Section 1 are – beginning on:

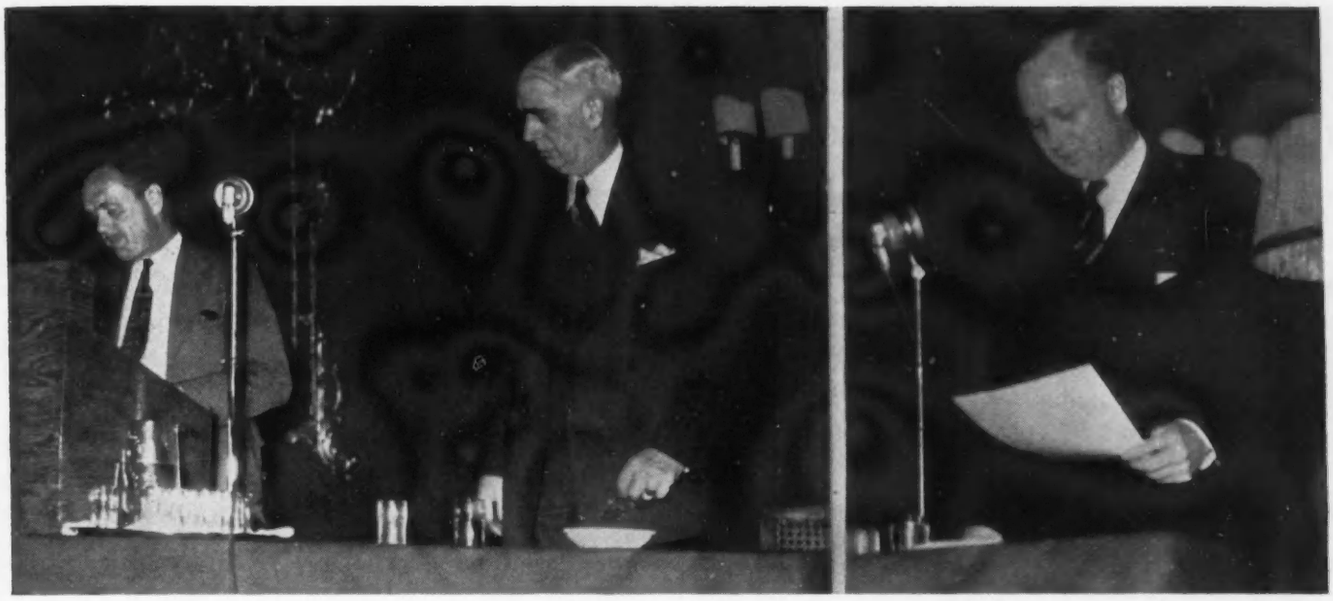
p. 14 – New York

p. 42 – Indianapolis

p. 43 – Detroit

p. 27 – Chicago

In Section 2 of this issue is told the story of the Congress activities on the Pacific Coast.



It will be long before any in the Tractor Session audience at New York forgets the friendly joust of facts and witticisms waged between the speakers of the evening, B. C. Heacock, president, Caterpillar Tractor Co. (left), and W. C. MacFarlane, president, Minneapolis Moline Power Implement Co. (right). SAE Vice-President J. S. Erskine, International Harvester Co. (center), was chairman.

ing certain gadgets and refinements so that identifying the part that the frameless construction alone plays in weight saving is none too clear." Cost saving, he pointed out, is even a more nebulous factor.

Design effects brought by the frameless construction were listed by Mr. Appel as including: 1. elimination of the outside coach builder even in Europe; 2. there can be no shifting of blame between body and chassis designers for body squeaks, rattles, and so on – the body and the chassis engineer become the same person; 3. because spring brackets, shock absorbers, bumpers, front frame extensions, and so on, are attached directly to thin sheet metal, particular care must be taken in providing local reinforcements to distribute the stress; 4. considerably greater rigidity in the underbody is required for convertible models.

Asking himself the question: "What about customer preference?", Mr. Appel answered: "From our observation, the buying public in neither England nor Germany (where General Motors units of both frameless and conventional types are produced and sold) seems to be the least bit interested in whether the car is of conventional or frameless construction as long as they feel that they are getting the best value for their money. Even in Germany where technical points are 'played up,' this feature has not aroused the slightest ripple of public opinion."

Discussion

The increased safety of the frameless cars is their most important advantage, believes Austin M. Wolf, consulting engineer, the first to be called to the platform by Chairman Zeder. He also pointed out that, in the frameless construction, the noise must be isolated as close to the wheels as possible, or a sounding-board effect may be obtained.

Herbert Chase indicated that Mr. Appel's paper had raised a number of questions in his mind. First, he wondered whether annual changes and improvements would produce any more of a problem in the frameless construction than in conventional designs. Were the designs discussed by the author truly frameless, or was a top merely added to a bottom shell or floor? How do they compare with the Lincoln Zephyr truss-type construction? He also wanted to know whether any efforts had been made to make further weight reductions through the use of light alloys in place of the conventional low-carbon steels, and whether any attempts had been made to eliminate weight by means of a three-point mounting that does not subject the car to torsional stresses.

In reply Mr. Appel reported that he saw or had experienced no special problems resulting from annual changes in frameless designs. According to the definition that "a frameless design is the final result of marrying a chassis frame to a body so that one cannot be distorted without imparting stress to the other," the designs discussed in his paper were truly frameless, he explained. He pointed out that some of the frameless constructions illustrated were for convertible models and, hence, could not depend upon the upper structure to act as a truss as is the case with the Lincoln Zephyr. As a general rule we do not use premium-cost light-weight metals, he replied to another of Mr. Chase's questions, adding that this is a cost problem that applies also to conventional construction. The three-point trunnioning brought up by Mr. Chase, he believes, would present new problems in car handling and durability.

The possible weight saving of 2% effected by a change-over to frameless construction does not seem to offer enough advantage to justify the change in factory technique and equipment, contended John G. Wood of Chevrolet. Such a change-over is hazardous, he explained, because no factory executive is able to judge every contingency, and a 5 or 10% increase in production costs is a serious matter.

"Is it feasible to build frameless cars without a tunnel?" asked Norman G. Shidle, SAE Journal, noting that surveys have shown that the American public did not like tunnels in their cars and that, as a result, many manufacturers had eliminated them. In reply Mr. Appel declared that it was feasible to build the frameless bodies without tunnels but that, in Europe, tunnels were employed to make the cars as low as possible and that, in these small cars, the tunnels are relatively narrow and short.

Hydrodynamic Power Transmission for Motor Cars – W. SPANNHAKE, Karlsruhe, Baden, Germany. (Presented by A. G. Herreshoff)

THE average fuel consumption using hydrodynamic transmission is at least equal to that for the same but mechanically geared car, and may even be lower, Mr. Spannhake contended. Although the average efficiency of the hydrodynamic transmission appears to be less than that of the mechanical transmission at constant speeds and steady driving conditions, experience under widely varying driving conditions, he pointed out, shows that the hydrodynamic power transmission, when carried out by an automatically shifting single-circuit gear, eliminates several causes of the difference between average fuel consumption and steady conditions, for example, interruption of the power transmission when shifting the mechanical gear; shifting at the wrong moment; and carburetor trouble when the driver takes his foot off the accelerator in order to shift. Besides, he added, the hydrodynamic gears have a certain free-wheeling effect.

The designation, "hydrodynamic" power transmission, is used in his paper, and not "hydraulic" power transmission, the author explained, because fluid gears are discussed that operate by dynamic action like turbines or centrifugal pumps, not those working by means of static fluid pressure like piston pumps. It is the dynamics of turbines and centrifugal pumps, he added, which has to be understood when the action of a hydrodynamic gear is to be explained.

Before giving the basic ideas of the hydrodynamic power transmission, especially when applied to motor cars, Mr. Spannhake defined his terms. A hydrodynamic gear which can take differences of torque between the primary and secondary shaft and which consequently is furnished with one or more fixed blade rows, he announced, will be called a "hydraulic torque converter," but such a gear, which consists of revolving blade rows only and, therefore, cannot take differences in torque, will be called a "hydraulic coupling." He presented considerable data explaining the basic operating principles of various combinations of these hydrodynamic gears and mechanical gears.

There are several reasons for the fact that automotive engineers have been comparatively hesitant to introduce the hydrodynamic gear into automotive engineering, the author concluded. Its characteristics are not as easy to understand as is the case with mechanical gears, and for motor drive, it will be necessary to develop special types for quantity production when proper and sufficient experience has been obtained. In so doing, the author predicted, many an advantage for their layout will turn up, and the overall economy will be increased still more.

Discussion

The problem of heat in hydrodynamic torque converters was emphasized by Oscar H. Banker, New Products Corp. Boats can utilize the heat developed by returning it to their turbines and thus raise the efficiency, he pointed out, but automobiles cannot do it. Efficiency also is a problem, he said, explaining that the efficiency obtained depended on the driver. The public alone can decide, he concluded, whether it wishes to sacrifice the efficiency of geared transmissions for the smoothness of the fluid or hydrodynamic torque converters.

P. M. Heldt, *Automotive Industries,* contended that these torque converters must be arranged so that the driver still maintains control.

J. Jandasek, Bendix Aviation Co., discussed important factors that affect the efficiency curve of these devices. He showed that the turbine or pump is practically a one-speed machine, and that the varying ratio of speeds depends on the angles of the blades of the turbines.

Modern European Light Cars **– J. ANDREAU, consulting engineer; president, Comite d'Etudes Economiques SIA. (Presented by Andre H. Jouve)**

A STREAMLINED car, using standard stock car parts and carrying the same number of people and the same powerplant as the 11-hp Citroën, has been designed and proved by tests to give 53 mpg at 30 mph and 39 mpg at 70 mph, Mr. Andreau announced after outlining the very direct relationship existing between automobile design and taxation in Europe.

This car, Mr. Andreau said, has an air resistance but one-tenth that of the modern car now produced. Its rolling resistance is reduced by use of higher tire pressures, made possible by improved spring suspensions to maintain present standards of comfort. Mr. Andreau described this car as "a 4-5 seater roomy car. Its motor is a 2-l Citroën 11 hp, and all the parts are standard. The car itself, although using the same mechanical parts as the Citroën stock car, is 30% lighter."

The tax collector has always been the "chief engineer" of motor-vehicle design in Europe, Mr. Andreau said, pointing out that France now "enjoys" more than 15 different taxes on its automobiles. Statistical studies of car sales growth in France and the United States, Mr. Andreau believes, make it possible definitely to plan the equalizing of production that can fill a certain program for several years. He thinks that it is now possible to act on demand first – before acting on production – and then get the necessary production to meet it, not the contrary.

Modern European Light Cars **– CHARLES B. BRULL, late director of the Citroën Laboratories, technical manager of the Citroën Trans-African and Trans-Asiatic Expeditions.**

A NEW riding sensation has been achieved through recent highly streamlined European body designs, according to Mr. Brull's description. When driving such a car with its streamlined body designed by his colleague, Mr. Andreau, he said:

"The hissing of the wind against the body is suppressed so that the driver absolutely loses this ingrained criterion for speed; the windshield remains absolutely clean as there is no frontal air pressure to stick mud or insects on the glass panels; rain drops run from bottom to top and are scattered instantly, thus rendering the windshield wiper unnecessary; and the stability is so great that the steering wheel becomes finger-tip controlled."

Although mass-production methods of manufacture have become the law everywhere in Europe since 1935, it takes three times as many man-hours to build a car in France as in the United States, Mr. Brull pointed out. It requires 75 times the normal day of work of one man in France to build an average car, and 25 times the normal work day in this Country, he said.

French output has remained stationary at around 200,000 cars for three or four years, he explained, partly because of the fiscal pressure of increasing taxation. As an example he showed that French gasoline taxes are 164% of the cost price of gasoline compared with 66% for England, and 37% for the United States. Not only has motor traffic been slowed down by this pressure, he said, but so also has the income brought in by such taxes. After portraying further some of the elements of the light-car problem in Europe, and particularly in France, Mr. Brull divided the European light-car market into three overlapping types, corresponding to distinct public requirements, and gave various European examples of each type:

1. The 2 to 4-seater, 5 to 6 hp, 2 to 4 cyl, weighing 800 to 1000 lb.
2. The 4 to 5-seater, 8 to 11 hp, 4 cyl, weighing 1500 to 1800 lb.
3. The 4 to 6-seater, 11 to 15 hp, 4 to 6 cyl, weighing 1800 to 2600 lb.

Among the more striking present types of European light cars reviewed in more detail by Mr. Brull are the 7, 11, and 15-hp Citroëns, the Peugeot 202 and 402, the Renault "Javaquatre," and the Simca 5 and 8 hp.

Discussion

After expressing his personal interest in the European small-car developments revealed in the two papers, Harry T. Woolson, Chrysler Corp., reported that, although a lot of work is being done on weight reduction, the trend in this Country is still toward larger cars, and that he did not look for much small-car development until the public indicated that they wanted them.

"The average person in the United States has an entirely false impression of European small cars," averred H. L.

Cooperative Success

THE SAE World Automotive Engineering Congress was the product of the minds of many men.

Cooperating actively with the officers of the Society was the SAE Congress Advisory Board, headed by Henry Ford as honorary chairman and having in its membership leading executives from every branch of the many-sided automotive industry. The Society's Meetings Committee, Ralph R. Teetor, chairman, had general responsibility for Congress arrangements, but every Professional Activity of the Society functioned individually and collectively to provide the outstanding program. Section chairmen and governing boards in New York, Indiana, Detroit, Chicago, Southern California and Northern California, all participated actively, while scores of committees and hundreds of individual Society members gave freely of time and effort.

In every respect the Congress was an outstanding example of cooperation voluntarily given – the sort of cooperation upon which the success of the Society of Automotive Engineers has been built.

A Few of the Speakers and Chairmen at the New York Sessions

1. E. L. Allen, Reid Products, Division of The Standard Products Co., and I. L. Carron, Dodge Division, Chrysler Corp.; 2. Col. G. A. Green, General Motors Truck & Coach, Division of Yellow Truck & Coach Mfg. Co.; 3. Col. E. J. W. Ragsdale, Edward G. Budd Mfg. Co.; 4. H. Menking, American Magnesium Corp., and Stephen J. Zand, Sperry Gyroscope Co., Inc.; 5. W. J. Cameron, Ford Motor Co.; 6. Merrill C. Horine, Mack Mfg. Corp.; 7. Sandro Sirtori, Alfa Romeo; 8. H. Blok, Royal Dutch Shell, A. G. Marshall, Shell Oil Co., and A. G. Cattaneo, Shell Development Co.; and 9. R. J. Nebesar, Avia Aircraft Corp.

Brownback, consulting engineer, speaking from experience on both sides of the Atlantic Ocean. Judging only from the small Austins or Fiats seen in this Country, he explained, little idea of the comfort and performance of the larger cars, such as the Citroën or Bugatti, can be obtained. These are really comfortable cars, he went on, although narrower, they have plenty of leg room; light weight has been achieved through small high-speed engines, frameless construction, and tubular seat construction. They give better economy at high speeds because of their lower and narrower lines, he said, and they have been given excellent high-speed stability by making sure that the reactions from the air resistance do not throw different weights on different wheels.

Surprising results in stepping up the output of European small-car engines by improved carburetion and other developments were revealed by Sandro Sirtori of Alfa Romeo. Starting with their 6-cyl, 2500-cc engine equipped with 1 carburetor that delivers 95 bhp in their standard stock car, he told how the same engine was made to deliver 140 bhp when equipped with 3 carburetors in a racing car, and 160 bhp when equipped with 6 carburetors – one for each cylinder – in an experimental car.

"Are European cars getting any easier to handle?" asked William J. Davidson, General Motors Corp. After driving one of the larger, heavier cars some time ago, he recalled, "it seemed as though the French people took their exercise by driving cars." Inaccessible gearshift levers and starting buttons, he noted, also contributed to the difficulty of driving. Mr. Davidson's views were seconded immediately by J. Webb Saffold, Saffold Engineering Laboratories. American cars handle easier, he explained, because the American public demands comfort. Nevertheless, he protested, "there still is no car built to accommodate comfortably a man over 6 ft. tall, such as myself."

Conceding that the American car of the same weight and capacity still steers easier than European cars, Mr. Brull reviewed the recent developments made to improve the handling characteristics of European cars, such as the pinion-and-ratchet steering gear and relocation of the gearshift lever. Contrasting the different commercial and public demands in different countries, he pointed out that the average European driver is very much interested in mechanical details, lifting the hood every few days, and does much of his own repair work.

Tire Behavior in Steering – **A. W. BULL, United States Rubber Co.**

DR. BULL emphasized the vital role that tires play in car stability, not only because they provide the final connecting link between car and ground forces, but also because they have inherent properties which are indispensable to safe and smooth steering control. Stability, however, is a relative matter, he explained, as the skill and experience of the driver enter into the problem to a very considerable degree. Pointing out that the factors in car or chassis design which affect stability are numerous and complex, he announced that his discussion would deal only with that portion of the problem which relates to the behavior of tires under the different conditions to which they are subjected.

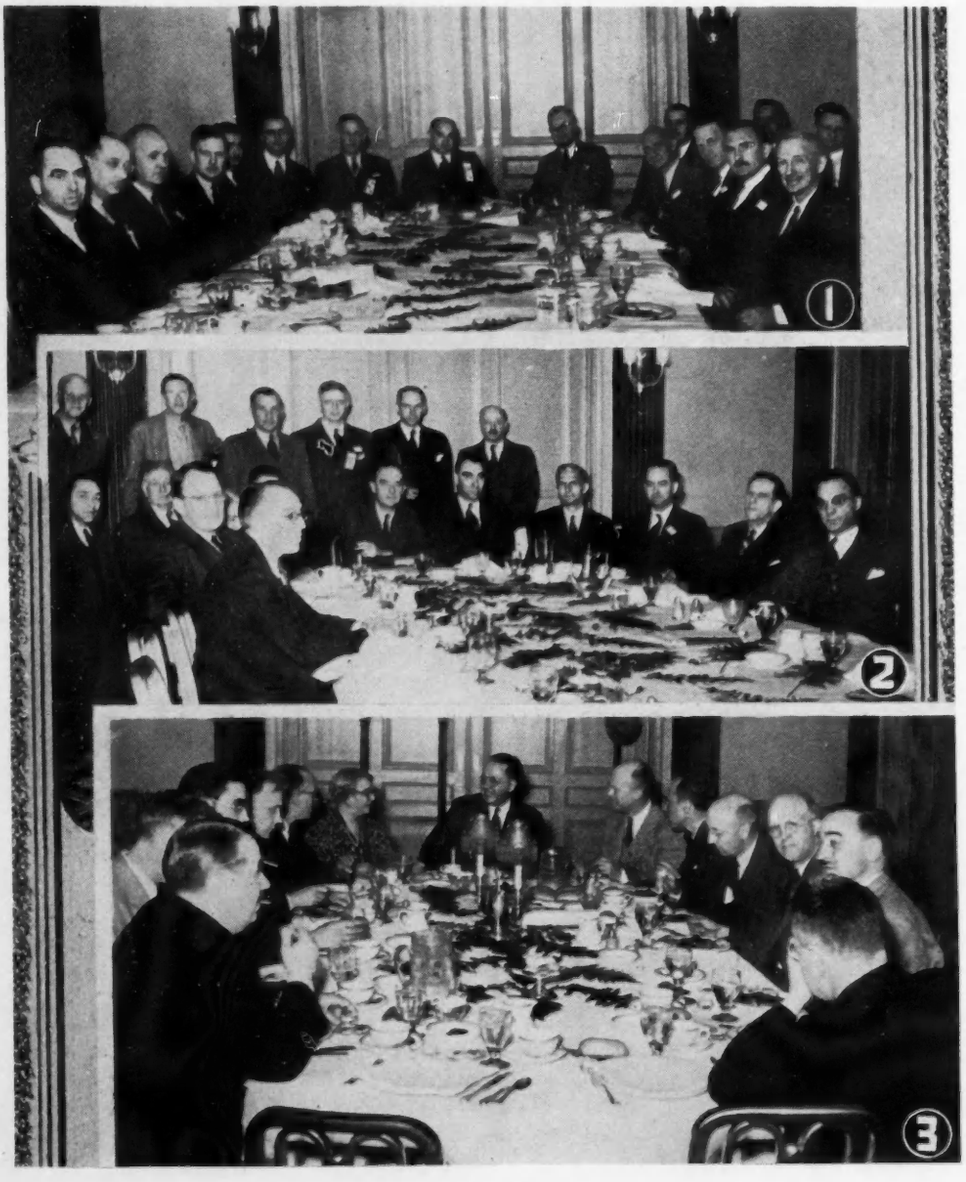
That stability is far from uniform among tires of different manufacture, and that speed has very little effect on cornering force under practically all conditions, are two of the conclusions reported by Dr. Bull from experiments made on a test machine built especially for studying the behavior of tires under a wide range of conditions. He presented data and charts to show the important relationships between slip angle, cornering force, load, inflation, self-aligning torque, and camber thrust. Results of work on the application of driving and braking torque, and on the effect of slip angle on the power consumption of tires, also were revealed.

In conclusion, Dr. Bull stressed the point made by other workers in the field – that stability is but one of the factors in tire quality and that, although it can be increased, the gain usually is at the expense of other desirable properties.

Discussion

Substantiation of Dr. Bull's findings that data obtained with the tire running on the curved surface of a test wheel differ little from those obtained with the tire running on a flat surface, was announced by T. J. Carmichael of General Motors Proving Ground, from results of the "Skid-Pad Test." The "Skid-Pad," he explained, is a large circular area very nearly level and paved with concrete. At the center of the area, a small pole is erected vertically, and around this pole at a radius of 108 ft is painted a circle which is used as a guide for the driver in making a test. He went on to describe how the tests were made with the aid of a pair of Autosyne motors for reading the steering angle of the front wheels, and of an engineer's transit mounted near the centerline of the car.

Slip angles in practical city driving vary between 2 and 4½ deg, disclosed S. G. Tilden, S. G. Tilden, Inc., reporting the results of tests using accelerometers, and the average in the city is about 2 deg 48 min.



Committee meetings were many throughout the Congress. Snapped in action at New York were:

(1) Sections and Membership Committees, Sections Chairman F. K. Glynn presiding.

(2) Fuels and Lubricants Activity Committee, Vice-President A. G. Marshall presiding.

(3) Diesel-Engine Activity Committee, Vice-President F. G. Shoemaker presiding.

Before the Speakers' Table Lined Up in New York

Past-Presidents of the SAE, and Vice-Presidents and Councilors now in office comprised the main body at the speakers' table at the New York Congress Banquet. They were introduced by Metropolitan Section Chairman Merrill C. Horine. Paul G. Hoffman was toastmaster and C. F. Kettering the speaker of the evening. With a few guests, they gathered for a social hour before the proceedings began.

Although the evaluation of tire properties by the methods outlined by Dr. Bull can be very useful to the automotive engineer, pointed out R. D. Evans, Goodyear Tire & Rubber Co., in written discussion read by J. C. Tuttle of the same company, it will be appreciated that road tests on the completely assembled vehicle remain the ultimate way in which the steering and handling refinement can be obtained. The great importance of a paper like this, he concluded, is not whether individual values may or not be accurate when translated into road performance, it is rather to bring out the basic laws and trends governing a mechanism which has such an important relationship to high-speed travel.

Passenger-Car Body Session

T. L. Carron, *chairman*

This session turned out to be a "field day" for expression of ideas about the future of automobile design. In addition to the wide range of topics in the paper itself, discussers touched on everything from concealed door-hinges to production for four-piece automobiles. The result was a fascinating, if somewhat indefinite, picture of the car of the future.

***Body Engineering – Past, Present, and Conjecture as to Future* – EDWIN L. ALLEN, Reid Products, Division of Standard Products Co.**

DELVING into the future to predict what is in store for us, Mr. Allen described vividly his conception of the car of tomorrow:

"In the not-too-distant future we will walk up to our car, push a button, and the door will open. We will have the impression of entering a commodious room. It will not be necessary to crawl around stationary seats and trip over bumps and tunnels in the floor. The seats will be light, movable chairs and the floor will be wide and flat.

"A portion of the roof will be made of a curved, translucent material which will admit the health-giving rays of the sun, at the same time removing the glare. A series of buttons will regulate the temperature and humidity to any desired condition of air. Pressing another button will unfold a concealed bed from out of the partition between the passenger and engine compartments. Many little passenger conveniences will be installed such as toilet and lavatory facilities. All of this can be done without increasing the width or height of the car at all, and the length only slightly.

"If the other branches of engineering keep pace with the body men, which they undoubtedly will, this car can be driven from any seat, the controls being carried or passed from place to place. As we glide along we will not be cut off from communication from the outside world. A radio speaker and microphone will be let into the wall. Without removing our eyes from the road we can again press a button and carry on a two-way conversation with our home or office."

The development in constructional design which appears to be nearest at hand is the so-called unit construction, he believes. Rear-engine mounting is inevitable, he reasoned, if cars are to become more blunt of nose and more tapered at the tail, adding his opinion that the change-over will evolve slowly. Speculating on future body materials and processes, he first took up the possibility of molding the complete body in large sections of some plastic material, giving his views on the improvements that must be made in the plastic materials and necessary changes in production equipment and processes.

"Is it beyond the realm of possibility," he asked, "to die-cast body panels directly from steel or some other material? What a short-cut it would be to inject the liquid material directly into the finished form instead of first rolling a flat sheet and then wrinkling it up into intricate shapes!"

The three major periods – past, present, and future – were considered separately in the light of their influence upon:

1. The body engineer himself, his development, his ever-changing responsibilities and opportunities.
2. Constructional design and probable reasons for adopting each successive type of construction used.
3. Styling and contour changes, illustrating trends affecting outward appearance.

Discussion

Chairman Carron led the discussion by reading a letter from Carl B. Parsons, which disclosed Mr. Parsons' opinion that automobile manufacturers will increase their sales through distinctive body designs. Cars are too much alike today, Mr. Parsons said, and only through new and unique exteriors can automobile producers hope to amplify financial returns.

Hinsdale Smith commented that the hood and front fenders on the modern car are a detriment to safety and a waste of

good material. Long hoods do not give clear vision of the road, Mr. Smith believes, and "inverted bath tub" fenders are too bulky for beauty.

To give better accessibility in modern cars, Mr. Smith suggested making the fenders and hood in one assembly, hinged to the dash and counterbalanced by springs. Another discusser said that such an arrangement was already in practice on some European models.

Mr. Smith continued with the thought that, if stylists insist on high hoods for appearance, they might build a compartment under the hood for the spare tire. This would leave the rear end baggage trunk for baggage alone.

The next point Mr. Smith brought up was destined to draw comment from many other discussers. He said that he was not quite converted to Mr. Allen's idea of an automatic door opener, because "a door with a spring heavy enough to open it when the car is tipped away from the person entering would make it difficult for a person attempting to shut the door when the car is tipped in the opposite direction, as at the side of a heavily cambered road."

Guido Soria of Fiat, speaking on this subject, said that while projecting door handles were objectionable the problem could be met without doing away with them entirely. He illustrated his point by drawing a diagram of the type of door handle now being used on Italian makes. Instead of being located in a horizontal position it is installed vertically, conforming to the shape of the door and projecting only slightly from it. This model is very successful in Italy according to Mr. Soria, and is not as radical a change as the automatic door opener proposed by Mr. Allen.

In answer to Mr. Smith on the subject of door handles, Mr. Allen revealed that there already is such a product as an automatic door opener and that the man who invented it was in the room at the moment.

Mr. Smith suggested transforming "the present belt molding into a horizontal bumper extending the length of the car and projecting an inch or two from the side." This, he said, would be valuable added protection in case of sideswiping.

For trimming, Mr. Smith proposed a heavy cotton duck in suitable colors as it would not be as clinging as woolen fabric, and unlike leather it would be warmer in winter and cooler in summer. It would also look as well as the slip covers used in many expensive cars, he averred.

Mr. Smith did not agree with the prospect of curved window glass in future cars for, he said, in the early days curved glass was tried and it was found impractical because it acted as a lens and approaching objects tended to distort and revolve.

Mr. Allen corrected his statement by saying that he did not mean the use of curved glass but rather of some transparent plastic which did not affect the vision such as that used in high-speed aircraft.

"Perhaps chassis engineers will adopt flat opposed cylinder engines with front-wheel drive," said Mr. Smith. "This would permit shifting seats forward to give a better ride in the rear seat."

On the topic of seating in the future rear-engined car Mr.

Before and after the sessions informal groups were intent on problems, were making new friendships or cementing old ones. Typical are three caught by the cameraman in New York.

(1) Following the Tractor Session: B. C. Heacock, Ralph R. Teetor, John A. C. Warner, W. C. MacFarlane and W. J. Davidson.

(2) After a Fuels and Lubricants Session: H. C. Mougey, Harry R. Wolf, and M. D. Gjerde.

(3) Waiting for the start of the Opening Session. In the foreground: A. L. Beall, G. L. Neely and W. M. Holaday. Directly behind them: A. I. Lipetz, Mr. and Mrs. Jean Paul Levi, and Count A. von Soden-Fraunhofen.

Soria brought up the point that if the front seat is located behind the front doors and wheels, as in present models, the driver would be at an unsafe distance from the windshield.

In answer to this Mr. Allen said that in all probability the seats would be movable; drawn back when the door is opened to allow the passenger to enter and then pushed up close to the windshield for driving convenience.

Joseph Geschelin proposed body jobs constructed of carbon steel tubing, but Mr. Allen said such tubing would be very expensive and would present a difficult joining problem. Another discusser stated that there might be an answer to this joining question in the near future as an airplane is now under construction whose design closely resembles that of the automobile body and whose fuselage is being made of such tubing.

Mr. Geschelin asked Mr. Allen if there was not some form of plastic body to be used in 1940. Mr. Allen answered that he does not know of any.

Body Production Argued

Discussing body construction led quite naturally to future production methods. Leo L. Williams suggested trimming and painting completely the component parts of a passenger car body before assembly into an actual body. Following the plan used at the present time in the construction of a popular motor passenger bus, Mr. Williams proposed "connecting all instruments to the dash and cowl before it is assembled with the chassis, connecting the floor construction to the running gear, setting up the front end, center pillars, rear side quarters and attaching roof and doors." The speaker felt certain that a great saving would be evidenced in shipping and storage of parts as well as in direct labor, by this method.

Mr. Geschelin said that, in constructing the car of the future, designers must be very careful to keep from hemming in the engine so that service will become increasingly difficult.

J. Webb Saffold felt that there could be more improvement in the comfort of seats. He thought it would be well for American designers to look into the use of sponge rubber and advanced spring constructions now in use in Europe.

Streamlining was brought into the picture with the suggestion by Mr. Soria of concealing hinges on future models. He said the movement was more advanced in Italy, than in the United States. Even though this is an expensive process, he stated, they are able to do it in his homeland because of the comparatively small production of automobiles in that Country and because much hand labor is employed.

Mr. Geschelin said that he did not agree with Mr. Soria on the great expense of concealed hinges as he knew manufacturers who were producing them at a moderate cost.

On the subject of streamlining, E. J. W. Ragsdale stated that a truly streamlined body is not practical because at high speeds a vacuum is created at the tail of the moving object rendering it uncontrollable. The truly streamlined body, Mr. Ragsdale said, can only safely be used in a strong headwind. Future cars may approach, but from necessity never actually achieve, perfect streamlining, the speaker forecasted.

Mr. Saffold approached the practical aspects of the subject by saying that he believed changes in design in the future will move much more slowly than they have in the past because of the great expense involved in revamping production methods every year or so.

R. M. Cregar, an operator of some 500 passenger cars, faced the group with an important present-day construction problem. He said that doors in the 1939 models are not hung correctly. To back up his claim he said that in 7000 miles of traveling the doors of some of his cars had to be reset three times.

Aircraft-Engine Sessions

Chairmen

Arthur Nutt — **H. K. Cummings**

E. P. Warner

Debate on long-mooted issues flared forth anew at the first Aircraft-Engine Session where questions of liquid-cooled versus air-cooled engines, sleeve valves versus poppet valves, the optimum size for aircraft cylinders, the limiting bmep for aircraft engines, and the revision of auto racing formulas, were clarified further in the light of recent developments and international experience. In a second session, fresh data on the vibration characteristics of aircraft-engine propeller systems promised to lessen the chance of fatigue failure of propellers. In the final session the history of the development of composite or "pick-a-back" aircraft was unfolded, and the tremendous strides made in aircraft-engine progress during the past 15 years were brought forcibly and graphically to the attention of those in attendance.

Some European Comments on High-Output Automobile and Aero Engines – **W. P. RICART and SANDRO SIRTORI, Soc. Anon. Alfa Romeo, Italy. (Presented by C. H. Huntington)**

CYLINDER measurements decidedly smaller than the normal ones used today in aero-engine practice are the most efficient for the best power/weight ratio with gasolines of technical iso-octane type, in the opinion of the authors. In fact, for high-power units, they believe that the whole architecture of aero engines must be revised if the maximum in output and the lightest engine possible is to be obtained.

High specific power output is a necessity for aero and racing engines, but is reached by different techniques for each type, the authors pointed out. Maximum power/weight ratio is the real basic criterion in aero engines, they explained, and the power-for-displacement technique dictates the present type of racing engines.

In both types they indicated that all factors are to be revised for every type of fuel and, with any fuel, present knowledge permits one to predict optimum dimension of cylinder for power/weight ratio and another for power-displacement ratio.

Racing developments with limiting displacement rules permitted in 1938 better than 145 bhp per l and 8000 rpm, it was reported.

Criticism of the present racing formula was made, and constructive comments were presented to encourage greater interest in future international racing.

Policy obliges them to develop engines for locally obtained fuels, and that condition makes a different problem than that for American conditions, they explained.

Mechanical tendencies were revised; and water injection was favored for take-off power or short overload period in preference to special fuels, they said.

Injection engines of advanced design were considered possible of high output in the near future, and the two-cycle engine was predicted to move to the foreground. Thermal fatigue was named as the principal problem of investigation to permit development of these tendencies.

Discussion

With the suggestion of the authors that a 120 cu in. cylinder is the optimum size for maximum power and minimum weight for aviation purposes, F. R. Banks, Associated Ethyl Co., Ltd., declared that he was "not in entire agreement." This value, he explained, reading from prepared discussion, of course, depends upon the total power required from a given engine. For a 1000 to 1200-bhp engine he conceded that it might be acceptable but, where 2000 bhp and upwards is desired, he submitted that larger cylinder sizes, of the order of 170 cu in., must be considered, "as the specific power which will have to be produced by the smaller cylinder will probably be so high that the cylinder scantlings must be increased and the weight for the 120 cu in. job will rise disproportionately." Speaking of the limiting bmep of 250 lb per sq in. quoted by the authors, he predicted that we will see maximum or take-off bmep's of between 250 and 300 lb per sq in. within the next five or six years, explaining that it probably will be some-

what easier and more satisfactory to obtain high bmep's than go to extremes in engine speeds. He revealed that bmep's much higher than 250 lb per sq in. are now being obtained experimentally.

Lee Oldfield, Schwitzer-Cummins Co., in written discussion, emphasized that automobile racing in the United States is sponsored almost entirely by individuals who race either for sporting interest or with the hope of financial profit. In no instance in recent years, he pointed out, has any racing activity been supported by any organization financially, physically, or mentally capable of doing the type of work indicated by the results described in the paper under discussion. He suggested that the authors could do a real service to the racing fraternity of the United States if they would elaborate on the reasons why their Company supports motor racing. A clear understanding of the attitude of Alfa Romeo, he concluded, might conceivably convert some American manufacturers to a racing program, or at least make them more cooperative.

In a third prepared discussion, C. Fayette Taylor, Massachusetts Institute of Technology, expressed his agreement with the authors' contention that displacement, as the only limitation on the output of racing engines, leads to engines so specialized as to be of little use for other purposes, and that the regulations should be revised with the aim of developing engines of more useful design. Noting that one limitation given for racing engines is the efficiency of the type of blower used, he asked the authors if they have considered the centrifugal type of compressor, and how its limitations compare with those of the Roots blower employed. Prof. Taylor joined Mr. Banks in requesting further explanation on the figures quoted for optimum cylinder size and limiting bmep. He also asked to be informed on the "remarkable resistance to detonation" of the engines described, in view of the relatively low octane numbers of the fuels burned and the relatively high compression ratios employed.

Although the better thermal efficiency of the smaller cylinders is an advantage, contributed Frank Nixon, Bristol Aeroplane Co., Ltd., they have mechanical disadvantages in large engines as they complicate design and add weight. Regarding sleeve-valve engines, he reported that pistons and piston rings were the least of their troubles.

Replying to his discussers through his interpreter, Mr. Huntington, Mr. Sirtori explained that they used the Roots instead of the centrifugal blower for racing cars because they found that it gave better efficiency for European road-race conditions, the hills and curves of which necessitated driving at relatively low speeds and high torque much of the time as compared with American racing conditions. The optimum aircraft cylinder size of 120 cu in., he said, was arrived at from practical considerations and experience. The limit of 250 lb per sq in. for bmep, he continued, was arrived at by tests with existing commercial engines and fuels. The antiknock characteristics were achieved, he told Prof. Taylor, through careful design of the combustion chamber and intake manifold. Although more complicated, the smaller cylinders for racing cars have been found satisfactory because of the limitations imposed by the racing formula, he reported. The reliability of the 150 bhp per l claimed, he replied to a question by Chairman Nutt, was proved by 100-150 hr runs on the test engine.

High-Output Aircraft Engines – **E. W. HIVES and F. Ll. SMITH, Rolls-Royce Ltd., Derby, England. (Presented by Dr. Smith)**

INDIRECT or liquid-cooled aircraft engines fit into the picture of future aircraft types better than do the direct or air-cooled engines, the authors contended. As reasons for their belief they drew attention to the small frontal area of this type; the heat capacity of the liquid in equalizing temperatures; and greater freedom in cylinder design because large heat-transfer surfaces are unnecessary.

Predicting that the engines must relinquish their present "privileged" position in the nose and leading edge of the wings, they said: "We think the time is not far distant when the customers' requirements will come first and the engine will be stowed away in any available remaining space. We already have had sufficient experience with shaft drives to regard this prospect with reasonable complacency. We should be more anxious if our engines were direct or air cooled." Answering complaints of maintenance trouble with the plumbing of liquid-cooled engines, they emphasized that these troubles no longer exist, and the system is now so reliable that the system can be filled with liquid and forgotten.

Rolls-Royce has been producing liquid-cooled aero engines for 23 years, they announced, and has concentrated a large staff on installation problems. One of the results of this work, they reported, has been the development of the interchangeable powerplant in which the engine-mounting auxiliaries and bulkhead form a complete detachable unit. These units, the authors explained, are interchangeable within 48 hr, and provide interchangeability between air-cooled and liquid-cooled engines.

In the remainder of their paper the authors discussed some aspects of the problem of increasing performance from a given power unit; dealt with the detonation and mechanical limitations to increased specific output; and described several recent developments.

Discussion

Confining his written discussion to the subject of aircraft-engine materials, John M. Lessells, Massachusetts Institute of Technology, emphasized that the use of tin as a coating for piston rings in order to prevent scuffing has indicated distinct advantages, and that attention is being given to aluminum and tin in the form of sprayed bearing materials. These developments by Rolls-Royce, he pointed out, are beyond the experimental stage since this new bearing material evidently has been widely applied in this company's engine products. Speaking of exhaust-valve materials, Mr. Lessells noted the corrosion troubles which the authors cited evidently have been eliminated by the use of the nickel-chromium alloy. In valves for extremely high pressure and temperature, he added, steam troubles also are experienced due to erosion effects. In this case, he concluded, the use of non-ferrous metals is being explored, and nickel chromium is one of them.

"Do the authors consider that an engine will be entirely enclosed within the wing in the next five years or so?" asked F. R. Banks, Associated Ethyl Co., Ltd., in his prepared discussion, referring to their remarks on engine position. He opined that demands for improved performance militate against complete housing because, in the first place, still greater power per unit is being demanded, and wings of small section and high aspect ratio appear to be necessary to obtain high overall performance. He agreed with the authors that there are certain objections to the use of water injection to raise the detonation limit, reporting that continued use of water injection in large diesel engines gives rise to a high rate of cylinder-bore wear. He explained his reasons for disagreeing with the authors' statement that the fully cooled, hollow-head sodium-cooled valve is more susceptible to hot corrosion than the stem-cooled type, and that the same benefit is not obtained with hollow-head valves of small diameter relative to similar valves of large diameter.

"In this Country it is believed that there is inadequate proof for the authors' statement that the effects of water additions to the charge in suppressing detonation are undoubtedly chemical as well as physical," contended S. D. Heron, Ethyl Gasoline Corp., in prepared discussion. Some authorities, he explained, consider that the physical effects of water in reducing charge and cylinder temperatures are sufficient to explain the observed behavior. Mr. Heron expressed his interest in the authors' theory as to the mechanism of exhaust-valve attack by lead oxide and stated that there are some data in this Country which would support it in part. The burning of the aluminum port subsequent to valve burning as described by the authors, however, he pointed out, was experienced by the Army Air Corps in 1922 with an unleaded benzol blend, and thus cannot be regarded as due only to leaded fuel.

Shifting the subject to the cooling system, L. M. Porter of

Donor Takes Part in First Presentation of Horning Award

(Left to right)

Mrs. H. L. Horning, who established the Award in memory of her husband;

Dr. H. C. Dickinson, who made the presentation;

Dr. Lloyd Withrow and Dr. G. M. Rassweiler, recipients of the Award. Dr. Withrow made a brief acceptance talk on behalf of himself and his colleague.

DR. GERALD MARK RASSWEILER and Dr. Lloyd Withrow had the honor of being the first recipients of the newly-established Horning Memorial Award for the best paper delivered before the Society relating to the adoption of fuels to internal combustion engines, or the adoption of internal combustion engines to fuels. Presentation of the 1938 award to the two scientists of the Research Laboratories Division of General Motors Corp. was made at the May 22 General Session of the SAE World Automotive Engineering Congress in New York by Dr. H. C. Dickinson, a past-president of the Society.

The paper for which the Award was made is titled "Motion Pictures of Engine Flames Correlated With Pressure Cards," and was presented during the 1938 Annual Meeting of the Society. It was published in the Transactions Section of the SAE Journal for May 1938, pages 185-204.

This occasion of the first presentation of the Horning Memorial Award was honored by the presence of Mrs. H. L. Horning. In a brief word to the gathering, Mrs. Horning expressed her pleasure in establishing the Award and thanked the Society of Automotive Engineers for having accepted its administration.

In making the presentation, Dr. Dickinson reviewed the vast services of Harry Horning to the furtherance of fuels and lubricants research, acclaiming him as "one of the guiding spirits in the growth of the new concept of mutual responsibility for orderly development of engines to suit the fuels which could be had and fuels to fit the engines which were needed by a growing system of highway transportation. From the beginning of his association with the SAE," Dr. Dickinson said, "Harry Horning was one of the leaders in creative thought."

New York University, noting the authors' statement that water has less tendency to "creep" through the joints than has ethylene glycol, asked Dr. Smith how far it was possible to go with pressures and mixtures before plumbing difficulties return.

"What was the attitude of the aircraft manufacturers when the idea of producing a complete powerplant unit was first introduced?" inquired T. P. Wright, Curtiss-Wright Corp.

His question was answered by R. N. Dorey, chief engineer of installation of Rolls-Royce, who explained that his company has been helping aircraft manufacturers since 1929 so the ingress of the idea was gradual. When it was finally proposed, he reported, the idea was "received with open arms." To another question concerning the vulnerability of the pressure cooling system to rifle fire, he opined that the cooling system was just as vulnerable to bullets whether under pressure or not. Asked for further information on the liquid-cooled engine's vulnerability as compared with that of the air-cooled radial engine by J. Webb Saffold, Saffold Engineering Laboratories, Mr. Dorey added that liquid-cooled engines were less vulnerable from the head-on standpoint but conceded that they were more vulnerable to bullets from the side. The radiator is a vulnerable point, he admitted, but will be made less so in the future. The underslung position of the radiator, he told Chairman Nutt, gave the best aerodynamic speed, and the cooling drag accounts for about 5% of engine power.

Although the Germans have only had to provide interchangeability for radial engines, contributed Mr. Nixon, the British have had to get interchangeability among liquid-cooled, air-cooled, and H engines. His contention that a weight comparison between air-cooled and liquid-cooled types would show "hundreds of pounds in favor of the air-cooled engine" was challenged immediately by Mr. Dorey who submitted that the results of such a comparison showed that the air-cooled engine was only 62 lb lighter.

After W. H. Hubner, Universal Oil Products Co.; O. G. Lewis, Standard Oil Development Co.; and Mr. Banks discussed the relative performance of various fuels in air-cooled and liquid-cooled engines, Neil MacCoull, The Texas Co., closed the session by praising the foreign engineers present for their frank and willing discussion of their problems and achievements.

Vibration Characteristics of Aircraft Engine-Propeller Systems **– CHARLES M. KEARNS, Hamilton Standard Propellers, Division of United Aircraft Corp.**

COMPLETE isolation of the airplane propeller from the engine, except for a very flexible torque drive, appears to be the only satisfactory solution of the vibration problem in the future, Mr. Kearns believes. Under such conditions, he explained, much lighter propeller blades can be used to maintain even greater horsepowers than are available at present so that, in spite of the trend toward more power, the increase in overall weight of the powerplant may be delayed considerably.

This problem of the vibration characteristics of the engine and propeller when operating jointly, he said, recently has become practically the determining factor in the selection of the proper propeller for use with a given airplane-engine combination. In the past few years, he announced, Hamilton Standard Propellers has undertaken an intensive investigation of this problem, studying both experimental and analytical approaches to the causes and solution of the high-stress conditions found in some engine-propeller combinations.

In his paper, Mr. Kearns discussed the various sources of excitation and resultant modes of motion frequently found in present-day powerplants. He also pointed out some of the present methods of treating vibration problems and mentioned possible future developments in this direction.

Discussion

Such thoroughgoing experimental studies of many actual propeller-engine combinations as Mr. Kearns has reported are required before there is any hope of designing propellers against fatigue failure in advance, believe W. Ramberg and L. B. Tuckerman of the National Bureau of Standards, according to their prepared discussion read by Chairman Cummings. The designer could not possibly investigate all modes and sources of excitation, they explained; he needs such data to know which of these modes and exciting forces are dangerous from the fatigue standpoint. They reported that they have been particularly interested in the flexural modes of rotating propellers and the stresses set up in this mode in their work at the Bureau. Suggesting that the possibility of subharmonic resonance should not be overlooked in the search for the exciting sources of serious vibrations in aircraft, they told how they proved that the source of serious wing and tail vibration in one plane was the blasts of air from the two-blade propeller passing near the wing structure.

Ralph M. Guerke, Curtiss-Wright Corp., read his prepared discussion at this point. He pointed out that reversing propeller rotation, keeping all else constant, will result in completely changing the vibration picture in many cases. It might be thus possible, he suggested, to alleviate vibration conditions simply by reversing the propeller rotation. The effect of blade material on the vibration characteristics of the engine propeller system, he contended, is much more pronounced than Mr. Kearns has indicated in his discussion of damping factors. In our tests on hollow-steel propellers, he reported, we have found to date that the ratio of the operating vibration stress to the fatigue limit of the material is more favorable in the case of steel than that of aluminum alloy. Propellers of combination wood-and-plastic construction, he pointed out, offer an ideal means of achieving the low weight to power absorbed ratio suggested by Mr. Kearns.

Speaking as a member of an organization that is a major consumer and operator of airplanes, Lieut. H. M. McCoy, U. S. Army Air Corps, emphasized that the Air Services were interested primarily in safety and freedom from operating restrictions on speed. In cases where it seems impossible to prevent restriction of operation in certain speed ranges to prevent dangerous vibration, he announced that they were working on an automatic control that will take the responsibility for restriction from the pilot. In closing, he reminded that equipment should be portable, and suggested that a central agency, such as the National Bureau of Standards, be delegated to calibrate and evaluate instruments such as strain gages.

Since restrictions are based on strain-gage readings, will Mr. Kearns tell us more about the constancy and reliability of the strain-gage readings? asked Earl V. Farrar, Wright Aeronautical Corp.

Reporting that there seemed to be no dynamic dampers in use in England, Frank Nixon, Bristol Aeroplane Co., Ltd., wondered if the reason that they did not seem to need them was that the Farnham reduction gears provided enough flexibility to do the work of the dampers.

The use of strain gages is more an art than a science, Mr. Kearns explained, replying to Mr. Farrar. Recalibrations of strain gages, he recalled, have indicated sporadic departures of 25%, but the majority indicate departures of 3 to 8%. Because of these departures, he said, we try to make as many duplicate measurements as possible to get a statistical average. In the hands of those used to using them, he concluded, an accuracy within 10% can be obtained at all times.

Answering Mr. Nixon, Mr. Kearns re-stated his belief that there are occasions when a dynamic damper should be used, regardless of the flexibility in the reduction gears.

The Composite Aircraft **– MAJOR R. H. MAYO, The Mayo Composite Aircraft Co., Ltd. (Presented by T. P. Wright, Curtiss-Wright Corp.)**

THE composite or "pick-a-back" airplane, the author explained, was evolved with the consideration of high wing loading coupled with a much higher power loading than that employed previously, the saving in weight of powerplant thus effected being utilized to increase the range and to provide for payload. The reduction in power, however, he went on, would render the aircraft completely incapable of taking off under any conditions without assistance. The idea of the composite aircraft, he revealed, was to couple the high-performance aircraft with another auxiliary aircraft of relatively low wing loading and sufficient excess power to insure a good take-off for the combination, and then to provide means by which the two units could be safely separated in the air at some speed well above the stalling speed of the heavily loaded unit.

The particular advantage of this method of assisting take-off of a heavily loaded unit, Major Mayo pointed out, was that the heavily loaded unit could be launched at a safe height and high speed and, at this height and speed, fuel could be jettisoned in case of engine or other trouble before making a forced landing.

In the remainder of his paper Major Mayo told how the problem of providing safe separation was solved by employing wings of different characteristics for the two components so that, as the composite aircraft accelerated, the lift would be transferred from the large lower component to the heavily loaded small upper component. He explained that, under these conditions, there would be a separating force between the two components which would pull them apart when the locking mechanism is released. He listed six safety features in the design and arrangement of the locking and release mechanism. The long-range upper component, he pointed out, is essentially of comparatively limited size and, therefore, is primarily suitable for high-speed long-range mail service. He indicated that composite aircraft can be either sea or land type.

In general, he concluded, the overall cost of composite aircraft will be substantially less than a corresponding service with normal-type aircraft for ranges of 2500 miles or more, providing elaborate passenger accommodation is not required.

Discussion

With a view to priming the discussion pump, Chairman Warner gave his impressions of composite aircraft. Questioning the extent of the advantage to be gained by using higher and higher wing loadings, he showed that, as wing loadings increase, aspect ratios also increase, a thicker wing is necessary, and operation must be at higher speeds and higher angles of attack until a point is reached when the losses catch up with the gains. The composite airplane, he believes, is essentially a device to reduce the take-off power required. Conventional aircraft for transatlantic flight, he estimated, are designed to carry about 8 to 10% of gross weight as payload; composite aircraft should carry 16 to 20% because of wing loading and reduced take-off power requirements.

T. P. Wright, Curtiss-Wright Corp., reminded his listeners that Major Mayo started his composite aircraft in 1935, and hence he could not incorporate in its construction many devices developed since that date, such as the constant-speed propeller and the two-speed supercharger. If he were to build one today, he pointed out, we could expect much better performance. The basic problem, he contended, is assisted take-off, and composite aircraft is only one of many ways to do it. Catapults and winches were mentioned as examples of other methods.

Present aircraft engines really supply their own take-off assistance, contributed Prof. C. Fayette Taylor, Massachusetts Institute of Technology, reviewing recent improvements in output. This is the reason why we haven't gone over to other types of assisted take-off in this Country, he explained.

Aircraft-Engine Development Progress **– ARTHUR NUTT, Wright Aeronautical Corp.**

ILLUSTRATING his points with numerous slides, Mr. Nutt gave a quick, clear, and complete picture of aircraft-engine development during the past 15 years. He showed that, in this period, specific weight had decreased steadily; reliability has increased; power has trebled; bmep has doubled; rpm has been stepped up from 1900 to 2500; and fins

have increased in area and depth, but their pitch has decreased. Fuels increased steadily in octane number until they reached 95 in 1936, he reported; then they went down to 90 in 1937 for economic reasons only. Mr. Nutt looked for the octane-number rise to continue as soon as the high antiknock fuels can be produced more economically. The recently developed dynamic suspension, he revealed, has reduced vibration in the structure by 40%.

Comparing German Junkers diesel performance with that of the Pan American Clippers, he showed that specific fuel consumption for the gasoline-engined Clippers was only slightly higher than that of the diesel planes – not enough, he feels, to compensate for the higher specific weight and loss of power at altitude of the unsupercharged diesel planes. Another chart showed that peak or take-off pressures for diesel and aircraft engines are about the same, but that the cruising pressures of otto-cycle aircraft engines are definitely lower. Fuel injection, he believes, has opened up a new field for otto-cycle engines, permitting the use of less volatile, safer fuels.

Contrasting liquid-cooled and air-cooled types, he opined that he saw no economy in building the liquid-cooled engines in the small powers, and that these engines will find their greatest use in military aircraft on account of their lower drag. He predicted that, if the flat engine comes, it will be confined to special applications. Sleeve valves will not be used in small engines, Mr. Nutt believes, because of increased cost.

In concluding, Mr. Nutt predicted that development will continue at the same pace as the last 15 years, but that the United States must continue to pour in money for development as other nations are doing.

Discussion

After emphasizing that he was not advocating the diesel engine for aircraft, O. D. Treiber, Hercules Motors Corp., speculated on the reasons for the specific fuel consumption of the Junkers diesels on transatlantic flights of 0.39 lb per bhp-hr, reported by Mr. Nutt. This figure, he feels, is too high. He contended that, on the basis of his experience and calculations, "we have a right to expect 0.28 lb per ihp-hr with natural aspiration."

At this juncture pertinent data just received from Germany were reported on the Junkers diesels. These data revealed that the output of the Jumo 205 was now 1000 hp, that it now weighs 1.5 lb per hp including the cooling system, and that its fuel consumption is now 0.34 lb per bhp at 20,000 ft.

Replying to Frank Nixon, Bristol Aeroplane Co., Ltd., who wondered whether poppet valves would be a limitation on speed increases in future engines, Mr. Nutt averred that there was no question that speeds and mep's would continue to go up, and that the limit with the American "too large" cylinders equipped with two poppet valves was not yet in sight.

Aircraft Sessions

Chairmen

William Littlewood **Stephen J. Zand**

The many gold and blue badges in evidence at the two well-attended Aircraft Sessions indicated the particular interest of foreign visitors in the subject. Two of the papers came from overseas.

Specific designs for transatlantic land planes were offered for consideration, and discussion on flight testing of large airplanes led to serious debate on methods of determining safe flutter speeds at the morning session. In the afternoon equal interest was shown in the development of a low-density material for aircraft structures and the use of magnesium in the aircraft and automobile industries.

Chairman Littlewood announced with regret that the scheduled paper, "European Commercial Airplanes," would not be given. Giuseppe Gabrielli, Fiat Co., the author, was unable to come from Italy, and the paper did not arrive in time to be read by a substitute.

Transatlantic Airplane Design Problems – **ROBERT J. NEBESAR, Avia Aircraft Corp., Prague.**

CURRENT modern American designs establish the trend of development in size of seaplane and landplane designs, Mr. Nebesar believes. The tell-tale charts of their characteristics and mainly of useful load-range-gross load relations are reported in his paper. Assuming that a cruising speed above 200 mph for transatlantic travel is a necessity, he deduced that, although seaplane design would have to go as far as 100-passenger 100-ton size in order to fulfill the requirements, the landplane of about half this size would do. The characteristics, weight, and performance estimates, and the general outline with the operation cost figures of a transatlantic landplane project for non-stop New York-Paris flight are revealed in his paper. The bright prospects of this solution, he believes, are made possible by systematic weight and drag savings, these savings being facilitated by the elimination of the otherwise necessarily big and heavy fuselage and by the advantageous wing arrangement, where comfortable accommodations for 48 passengers are provided and where the great gasoline load is distributed along the span. For comparative purposes he supplemented the project, TA-2, with the project, TA-1, differing only in fuel capacity.

Discussion

Supporting Dr. Nebesar, T. P. Wright, Curtiss-Wright Corp., noted that there is a slight trend in this country toward the use of land planes for over-ocean flying, and called attention to Pan American's recent purchase of Boeing 307's for a course, much of which lies over water. Col. V. E. Clark, Clark Aircraft Corp., stated his opinion that land planes will not prove their true advantages while take-offs are limited.

Real interest was shown in the designs offered by Dr. Nebesar. When questioned by Chairman Littlewood about the use of magnesium fuel tanks, the speaker told of instances where they have been in use for 6 years without trouble due to corrosion or vibration. He pointed out that in his Country ethylized gasoline is not used, but that he understands it does attack magnesium. The chairman also asked if having fuel

Chicago

BASEBALL vied with shops and museums as attractions for Congress members during their day in Chicago, where they were entertained by the SAE Chicago Section.

Upon arriving from Detroit the delegates were met by Chicago Section Vice-Chairman William H. Hubner, who escorted them to the Bismarck Hotel.

After freshening up, most of the Congress group spent the morning on a sightseeing trip which took them to the Edgewater Beach Hotel and then down Chicago's famous Outer Drive to the Museum of Science and Industry in Jackson Park, site of the Columbian Exposition in 1894.

After lunching at the Bismarck, the party split – one group watching the Chicago White Sox trounce the Washington Senators, while others visited Chicago's smartest shops and the Art Institute.

An impromptu musicale was staged in the early evening with typical pieces of different nations being played on the piano by Capt. L. Callingham (England), Dr. S. Sirtori (Italy), and A. B. Willi (U.S.A.).

Train time came and Congress delegates embarked on the Super Chief for the last leg of their journey.

tanks located in the outer wing would not affect the maneuverability of the plane depicted. Answering that there would be some effect on control, Dr. Nebesar pointed out that, upon landing when control is most needed, there will be less weight and less effect.

Dr. Nebesar sees no reason why problems of landing gear design for large planes, suggested by Charles Froesch, Eastern Airlines, should not be overcome, but noted that there might be some trouble with tires and tubes. He also spoke of advances in brake and wheel design to overcome the increasing kinetic heat being developed as weight and landing speeds of airplanes increase.

The Testing of Large Aircraft **– E. T. ALLEN, Consulting Aeronautical Engineer. (Presented by David Gregg, Eclipse Aviation, Division of Bendix Aviation Corp.)**

THE organization, training, attitude, and esprit of the crew are all-important for successful flight-testing of large aircraft, Mr. Allen asserted. These problems, he explained, are similar to those involved in the functioning of a military unit or of a city government. Choosing the required personnel of from 3 to 10 men fitted to their various duties, he said, training and coordinating them, and building up an efficient unit for collecting accurate flight-test data under conditions of hazardous operation devolves upon the chief test pilot.

Since flight-testing involves continuously extending the range of investigation of flight characteristics toward margins of safety, he pointed out, the principle of least hazard has been developed to guide all flight planning and all test operation. This least-hazard principle guides the testing of structure and functional systems through the initial flights, stability tests, performance tests, and flying qualities determination.

The high cost per minute of test flying is another factor of extreme importance brought out by Mr. Allen. "It so profoundly influences the planning and the conduct of each flight," he said, "that very frequently, when a specific test flight lasting as long as an hour is repeated later, the time for each of the repetitive tests is identical, down to the minute," so accurately do they follow the detailed flight plan.

Flight-testing techniques have developed so rapidly during the last few years, and particularly during the last few months, Mr. Allen qualified, that any attempt to define the status of the art becomes obsolete at once. "It is no longer a field for the test pilot of movie conception; it is the work of the aerodynamicist."

Discussion

Insurance rates for test flights have taken a decided rise in the past year due to six accidents which have cost the insurance companies about $1,500,000, said Jerome Lederer, Aero Insurance Underwriters. Four of these accidents, he reported, were caused by test pilots being ordered to do things that they were not supposed to do.

One thing that Mr. Allen did not bring out in his paper is the test pilot's important job of training pilots to succeed him, Mr. Lederer noted.

Flutter is the most serious hazard encountered in test flights, said Mr. Wright, who stressed the importance of determining flutter speeds by ground tests, so that they will not be reached in flight tests. Greater use of torque meters and their increasing reliability, he added, are limiting inaccuracies.

Dr. G. V. Lachmann, Handley Page, Ltd., spoke of the dangerous effect of looseness of control tension on flutter, and expressed his surprise that there is still widespread use of cables and pulleys in the United States. In England, he said, push-pull rods and tie-rods are generally used. Michael Waters, Edward G. Budd Mfg. Co., informed Dr. Lachmann that tie-rods are being used extensively in this Country, particularly on the larger planes.

It was suggested, by Col. Clark, that by dynamic and/or static overbalancing of planes in free suspension, and by adding or decreasing weights, much can be learned about flutter speeds.

We have good theories of flutter speeds, but do not have the full picture because of the danger of determining them in test flights, Mr. Waters said. He suggested artificial mass unbalance by attaching weights to flutter-prone parts. At the inception of flutter, he continued, the weights would be disengaged, mass unbalance overcome, and a safe flutter speed would result. Thus, calculated flutter speed could be checked on an air-borne plane, he added.

Referring to the suggestion of Dr. Lachmann that it is advisable to test a flying model of a large plane, Mr. Waters said that it definitely is desirable, but that it does not give data on flying systems and mechanics of various devices, which are important. Test models have been used in this Country and in Europe, he said. In the case of a seaplane, he added, tests with a flying model gave the answer on handling characteristics on water and, to some extent, performance.

A Low-Density Material for Aircraft Structures **– V. E. CLARK, Clark Aircraft Corp.**

THE necessity for stringers and rivets now required in all-metal airplane wings and fuselages, resulting in slow and costly production, may now be eliminated by the substitution, in the shells of airplane wings and fuselages, of a skin having sufficient *thickness* to resist compressive stresses without buckling, Mr. Clark contended. "Duramold" is such a material, he announced, suitable for the structural elements and covering of aircraft; it represents, in its final form in a finished aircraft, a new combination of materials and processes. For equal weight, he explained, the thickness varies inversely as the density of the material, and the efficiency of a material for this purpose depends upon its modulus of elasticity and the *square of the thickness.*

The material in final form, he continued, must be sufficiently non-hygroscopic to meet all practical requirements of airplane service, and it must be free from attack by molds and fungi to attain the desired objective. The basic material and class of labor required must be readily available in large quantities and from many sources, he stipulated, and the processes and apparatus must be of such nature as to bring the cost and time of production to the minimum.

The basic principle of its fabrication calls for the utilization of the fine natural cellular structure of certain species and grades of straight-grained wood for strength, rigidity, and energy-absorbing characteristics, Mr. Clark pointed out, and the preservation of these characteristics and the dimensional form of aircraft parts is obtained by the addition, under controlled treatment processes, of certain resinous products.

He showed how the technique in forming shells and other parts permits smooth permanent compound curvature in long wide pieces with small radii in both directions.

The resulting aircraft parts have structural characteristics as favorable as with the finest grades of low density plywood when new, he asserted, and they maintain these characteristics without appreciable deterioration throughout long operating service in various, and varying, climates.

Discussion

Duramold's low specific gravity, which Col. Clark said may be accurately controlled plus or minus 3% within a range of from 0.5 to 0.9, was favorably commented upon by T. P. Wright, Curtiss-Wright Corp.

At his suggestion, Chairman Zand called upon Dr. G. V. Lachmann, representing Handley Page, Ltd., to report advances of similar materials in Europe. He spoke particularly of a method of pressing out hollow propeller blades that are both light and strong. The optimum density is considered 0.9. Density up to 1.2 is used near the hub, tapering off toward the tips.

Col. Clark mentioned that he favors a density of 0.6 for fuselage and wing structures because greater thickness may be used.

When asked how large a production is necessary to amortize Duramold molds within a reasonable time by Dr. Lachmann, the speaker said that, according to his conclusions, production of 150 to 200 machines would merit the cost of molds.

Pure plastics were condemned for use in structural parts by Dr. Lachmann, who said that he is convinced that a base of wood fiber is needed.

It was noted by Mr. Wright that to get best results from Duramold technique it is necessary to go 100% to fully stressed construction. This was agreed to by Col. Clark.

When questioned about stresses around holes in a Duramold fuselage, the speaker explained that it is necessary to develop new derivations of fundamental design. In general, he added,

the stresses flow around holes much the same as they do in all-metal construction.

The Use of Magnesium Alloys in the European Automotive Industry – **H. ALTWICKER, I. G. Fabenindustrie, Germany. (Presented by H. Menking, American Magnesium Corp.)**

HOW magnesium alloys can be used in automotive construction depends on whether an existing construction should add magnesium-alloy parts, or whether a new construction is to be built, the author pointed out. In the first instance, he explained, there is the possibility of replacing parts which get little use; in the second instance, there is the possibility of extensive use of magnesium alloys for much-used parts. He illustrated his points by examples taken from Germany and other countries, comprising single parts of automotive construction, as well as assembled constructions in the form of complete automotive structures.

In discussing the uses of magnesium alloys in aircraft, he first dealt with the performance of such alloys in older aircraft construction. These performances, he reported, substantiate the impression that the corrosion stability of magnesium alloys for the purpose of landplane construction is ample. By far the greatest use of magnesium alloys is in molding, he indicated. Explaining the various possible uses of these castings for intensively used parts, he mentioned the use of these castings in the formation of press dies of Elektron castings for mass production of stampings. In the form of forged and die-cast parts, the magnesium alloys have won a large market for themselves, he said, explaining that these parts are particularly suitable where great wear is demanded. The development which has taken place in this field has brought out the advantage that, economically and certainly as a weight factor, single parts which until now have been joined by welding or riveting, might well be forged in large pieces and by large presses, he pointed out.

The suitability of the use of magnesium alloys, he summarized, can be judged only when all factors with which it is concerned have been considered. To this classification belongs:

The choice of alloys for a specific purpose, and its advantageous molding properties (sand-casting, ingot-molding, press- or roll-material).

Constructive shaping with consideration of the E-module notch sensitivity, and corrosion stability.

Discussion

After presenting Dr. Altwicker's paper, Mr. Menking told of the great growth in the use of magnesium in the United States. It is available in many forms, and has a wide range of applications, he said, prophesying that its uses will be extended as engineers become more familiar with the material.

Chairman Zand, who noted that his company probably uses more magnesium than any other excepting engine builders, extolled its merits but warned engineers not to use it blindly. There is a tremendous fire hazard if magnesium is not machined correctly, and corrosion must be guarded against, he said.

To avoid fire, Mr. Zand explained, machines must be kept free from chips, tools must be kept sharp, and plenty of lubrication must be provided. Mr. Menking noted that special tools have been designed to keep down friction heat, and declared that they should be used in working with magnesium. These tools, he added, have wider clearance angles and their surfaces are smaller than tools used with other materials. In case of fire use sand or chemical extinguishers, as water is not effective, Mr. Zand advised.

When asked about corrosion, Mr. Menking explained that magnesium is not recommended when salt-water immersion is inevitable, but that it can be used satisfactorily near the seacoast if properly painted. It is also important, he said, to insulate it away from brass, other copper-base alloys, and ferrous alloys. While most oils do not corrode magnesium, there are some that do, he noted.

For screws and rivets to use with magnesium, Mr. Menking recommended a special aluminum alloy with 5% magnesium which has the same strength as Duralumin, when asked by Harold Caminez, Aircraft Screw Products Co. It was also brought out that it is not necessary to insulate against anodized metals or metals with certain other coatings. Mr. Zand said that tests indicate 18 and 8 stainless steel to be one of the best materials to use with magnesium.

Tractor Session

J. R. Erskine, *chairman*

At the Tractor Session, good-humored banter between the eminent speakers vied with well-marshalled facts about the value of tractors to the American economy in producing one of the Congress' most interesting events. Motion pictures of tractors at work were an additional feature.

Automotive Engineering in Agricultural Mechanization – **W. C. MACFARLANE, president, Minneapolis Moline Power Implement Co.**

FROM its inception, farming was an occupation necessary to give man bread, Mr. MacFarlane pointed out, showing that, with the advent of animal power, the farmer learned that he must also raise food enough for his beasts of burden – and so the acreage increased. As new farming ideas sprang into being, new inventions and improvements came into use.

The tractor industry today, Mr. MacFarlane said, is able to place in the hands of the user a tractor that not only performs the work for which it was originally designed, but that also adds comfort and pleasure to the work. This is in line with the efforts of the automotive industry as a whole to lessen back-breaking labor and drudgery.

Comparing tractor with automobile problems, he said that tractor companies begin where automobile companies leave off as regards number of models and variations available on individual models. Tractor men will continue to look to automobile men, he said, for much important equipment and predicted for the future many new products and many improvements in present ones.

The Track-Type Tractor's Contribution to Economic and Social Progress – **B. C. HEACOCK, president, Caterpillar Tractor Co.**

AN enormous acreage of fertile land around the globe is now in cultivation only because of track-type tractors, Mr. Heacock contended. This achievement was made possible, he explained, because they can travel across the softest footing without miring. For this reason – because it puts less weight on the ground per square inch than a man does with his foot – he pointed out, the track-type tractor has proved a great boon in the rice fields of Louisiana and California where the water buffalo and the coolie had been the only sources of power since the dawn of history. Such a miracle has it worked in these rice fields, he continued, that rice produced in American fields, under American standards of wages and living conditions, is being shipped across the Pacific Ocean and is being sold in China and Japan in direct competition with rice produced in those countries by coolie labor that receives only a few cents a day.

Mr. Heacock continued his descriptions of various workaday jobs of the track-type tractor that have contributed to our social and economic good with road-building, construction, logging, war-time, oil-field, telephone-company, and railroad applications. Concluding with examples of the dramatic side of tractor usefulness, he told of tractors pulling long trains of sleighs deep into the Arctic North, playing an outstanding role in the development of this rich and frozen wilderness; and of their part in transocean airline development and in flood relief.

Truck, Bus & Railcar Sessions

Chairmen

C. J. Bock **M. C. Horine**

Those attending the TB&R Sessions, Thursday morning and afternoon, were brought up to date on the relative merits of stainless steel and aluminum in the construction of truck and bus bodies and parts, and they heard differing opinions regarding the comparative efficiencies of various types of transmissions. One discusser suggested solving the latter question by eliminating transmissions entirely.

Engineering Problems Involved in the Use of Ferrous Metals to Reduce Weight – **E. J. W. RAGSDALE, Edward G. Budd Mfg. Co.**

THE inherent stability of a flat wooden panel is 250 times greater than that of a steel sheet of like dimensions and weight, Mr. Ragsdale revealed. With this seemingly great disadvantage, he indicated how, by folding and shaping of the steel, an even superior structure can result.

These facts, he said, explain why light-weight construction has progressed first through wood, then through the lighter alloys, and has finally come to high-tensile steels.

Stressing the human side of the equation, he commented that a true light-weight construction depends as much upon the urge and ingenuity of the engineer as it does upon having available methods and metals suited to the requirement.

The author treated his subject with a philosophical whimsy rather than from a strictly technical point of view. Establishment of principles and fundamentals were considered of first importance. The methods of applying these principles to actual practice were merely indicated and not definitely developed.

Finding that stability is the keynote of light construction with steel, he expanded the theme to show how steel structures can be made stable. The term is used, he explained, to cover stability of the sheet, stability of thin-walled columns, joint stability, and even extended to include a stability of the steel against corrosive failure.

Light-Weight Transportation Units – **FRANK JARDINE, chief engineer, Casting Division; A. H. WOOLLEN, railway engineer, Development Division; D. S. MUSSEY, engineer, Development Division; of the Aluminum Co. of America. (Presented by Mr. Jardine.)**

THE general tendency to increase the speed of all forms of transportation and to reduce the cost of operation; legislation governing the maximum gross weight of vehicles traveling on the highways; and laws establishing the minimum speed at which trucks and buses can travel up a given grade, combine with other factors to make low gross weight of prime importance in these units, the authors pointed out in introducing their paper.

By the use of carefully considered designs, they stated, any transportation unit in use today can be made largely of aluminum and considerably lighter than the same unit made entirely of ferrous materials. In most cases, they declared, it is possible to make a weight reduction of approximately 50% from the weight of an iron or steel part when aluminum is used.

Results of a test made on a 36-passenger aluminum alloy bus, they reported, indicated that calculated stresses do not correspond very closely with measured stresses. This is attributed to the fact that a bus body is a complex, statically indeterminate structure and the accuracy of design calculations is wholly dependent upon the accuracy of the assumptions upon which they are based. In this test, they said, the measured stresses were on the average one-fourth as great as those calculated and, under normal operating conditions, dynamic stresses were as much as three times measured static stresses. Details of this test were given. Strain gages were used to measure the stresses actually occurring in the parts under loaded conditions.

The authors emphasized the necessity of local stability, or the ability of the members in a bus body to withstand maximum loads, both service and accidental, without permanent distortion. The high tensile strength of the alloy steels cannot be fully utilized, they maintained, because to do so would result in the use of sections so thin that they would buckle locally and collapse. It is in this respect, it was stated, the superiority of the light metals is greatest, due to the fact that a lighter, thicker cross section can be used generally with increased strength, because of the lower specific gravity of the metal.

In concluding, the authors recommended materials to be used in different parts for buses and light railcars.

Discussion

Another point of view on the use of ferrous metal to reduce weight was contributed by J. W. Halley, Inland Steel Co., in written discussion presented by J. H. Nead, of the same company. He stressed the advantage of low-alloy high-tensile steels costing an eighth to a tenth as much as 18 and 8 stainless steel. Their corrosion resistance is 4 to 6 times that of plain carbon steel, they can be welded on standard equipment without special precautions, their strength is inherent and not a result of cold rolling, and many have excellent impact resistance, he reported.

When asked about repairing bodies of corrugated stainless steel, Col. Ragsdale answered "they do it." He told of instances where badly smashed bodies and railcars have been satisfactorily repaired and stated that "it takes a little knowing" to do the job. Welding machines and the materials have been shipped in case of rail accidents, and the railroad's own men have done the repair jobs, he reported.

Power Transmissions for Buses – **COL. G. A. GREEN, General Motors Truck & Coach Division of the Yellow Truck & Coach Mfg. Co.**

THE transmission, as we know it today, can only be regarded as a necessary evil, since it merely serves to compensate very poorly for the powerplant's low-speed torque inadequacy, stated Col. Green. What we really need, he added, is a prime mover with the torque advantages of steam but without its prohibitive complications, hazards, inefficiency, excessive weight and cost.

Noting that the possibilities of electrical propulsion are by no means exhausted, he said that fundamentally this system better meets the needs of the average bus operator than any other, but in its present form is too heavy, too costly, and too inefficient.

Col. Green restricted his discussion of transmissions to the current production designs offered by the world's eight leading bus manufacturers, including the following: electrical propulsion; semi-automatic planetary transmissions; fluid flywheels; hydraulic transmissions with both manual and automatic controls; synchromesh transmissions; transmissions other than synchromesh, automatic and semi-automatic; method of providing drive between transmissions and rear axles for American vehicles with transversely mounted rear and underfloor engines.

All of the transmissions discussed, Col. Green declared, are compromises in one way or another. The hydraulic transmission is no exception, but from the standpoint of the city service vehicle it is, in his opinion, superior to anything that has been developed to date. He added that in the present state of the art its application cannot be considered for long-distance, high-speed operation where very steep grades are encountered.

In the bus and truck field, the fluid flywheel has opened new channels for transmission development work and in the not far distant future we shall see this mechanism employed with more or less conventional transmissions, Col. Green stated. He added that such an arrangement has interesting possibilities.

Discussion

The unique manner in which Col. Green presented his paper received many favorable comments from those attending the session. Slides were shown simultaneously on two screens. On the left screen were charts and illustrations, and on the right, notes pertaining to them, from which the speaker spoke.

In the early part of the discussion Oscar H. Banker, New Products Corp., took issue with proving ground figures offered by Col. Green which showed at 20 mph in direct gear the fuel economy of hydraulic transmission described to be 5% greater and of automatic geared transmissions 6% greater than synchromesh transmissions. Mr. Banker countered with reports from operators which showed economy of buses equipped with automatic geared transmissions to be from 12% to 26% greater than those equipped with hand-shift transmissions. He quoted other figures which indicated hydraulic transmissions from 5% to 7% less efficient.

Sticking to his figures, Col. Green offered to repeat the proving ground tests, if anyone needed to be convinced.

It was reported that a hydraulic transmission weighs 1.41 lb less than a corresponding synchromesh transmission, in answer to a question by Robert Cass of White. Mr. Cass quoted figures from a London bus operator, supporting those of Mr. Banker, showing efficiency of hydraulic transmissions less than gear transmissions.

Martin Schreiber, Public Service Coordinated Transport, said that, in his opinion, there are so many other advantages to having automatic transmissions that one can afford to give up some efficiency. He reported favorably on the reactions of the drivers and service men with buses equipped with electric transmissions. Some of these units, he said, have more than 500,000 miles of service behind them.

Howard A. Flogaus, J. G. Brill Co., stated that his company has pinned its faith on the fluid flywheel, using a jaw clutch shift transmission, and thus obtains the advantages of an hydraulic transmission with the efficiency of a gear transmission.

Elimination of the transmission was E. S. Hall's solution of the problem, and this, he said, can be done with the development of a constant-compression completely-variable-stroke gasoline engine. Its economy would make that of the diesel look sick, he added.

Transportation and Maintenance Sessions

Chairmen

T. C. Smith **T. L. Preble**

H. O. Mathews

The complexity of jobs held by T&M men was indicated by the diversity of papers presented at the three sessions arranged by their Activity.

Ideas on the comparative merits and applications of gasoline, diesel, and Hesselman engines were exchanged; the development of standards for maintenance urged; and variance of agreement developed regarding methods of purchasing new equipment, free dealer service on new vehicles, and other operating problems. A report on a 25,000-mile road test brought out interesting observations on driver fatigue as well as the general ruggedness of today's motor vehicles.

Two of the sessions were devoted to problems of public utility fleet operators, and in connection with the Congress a special meeting of the Public Utility Fleet Supervisors' Conference was held Monday evening. Jean Y. Ray, Virginia Electric & Power Co., was in the chair.

Comparative Utilization of Gasoline, Hesselman, and Diesel Engines **– JAMES E. DeLONG, Waukesha Motor Co.**

IN spite of the millions of dollars' worth of publicity given to the diesel engine as a modern transport power, its actual adoption has been very slow, amounting to approximately 0.10% of the total number of vehicles on the highway, the author pointed out. His paper consisted of a survey of the commercial automotive transportation field in the United States, reporting on the number of oil engine driven buses and trucks.

Reporting a further survey of the causes for this slow penetration in such a vast market made among fleet owners who are large operators, he disclosed that the two chief obstacles are weight and price. He then demonstrated that both weight and price are purely comparative values, but that the comparison is made against a highly refined, quantity-produced power unit in the present gasoline engine, and that any competitor, to make inroads on this market, must stand that comparison. Today, the two major obstacles appear to be inherent and a function of the pressure and stress factors in the operation of the compression-ignition engine, he asserted. Furthermore, he continued, the additional cost of injection equipment with conventional design, even on a high-production basis, does not offer a very great opportunity for price reduction, even though ignition devices are omitted from the diesel engine.

The problem then becomes one of finding a solution, probably outside of the conventional compression-ignition engine, and the low-pressure Hesselman cycle seems to offer this opportunity, Mr. DeLong reasoned.

A new design of Hesselman engine which can be built with the full benefits of quantity production side by side with a gasoline engine, a natural gas engine, or a propane engine, with all major parts interchangeable, the engines themselves being identical throughout the production and manufacturing processes and becoming either oil engines, gasoline engines, or gas engines in the shipping room by the installation of the appropriate accessories, was described by the author. The service problem, by this uniform production, is simplified greatly, and costs as between gasoline, propane, or fuel oil then becomes merely the differential between the cost of carburetion equipment and fuel injection equipment, he pointed out.

The economical implications of such a design have widespread significance because this new-type engine is found to be better than existing gasoline or existing propane engines on fuel economy, and very nearly equal in fuel economy to the compression-ignition diesel engine, Mr. DeLong contended.

Discussion

Chairman Smith had no difficulty in eliciting discussion of Mr. De Long's presentation. Diesel men were quick to come to the defense of their engine which one speaker said the author had "damned with faint praise," and several questioned his estimate of the number of diesel-powered vehicles in the United States. One discusser from overseas told of amazing strides being made in England and Scotland where some 28,000 compression-ignition trucks and buses are on the roads. Interest was general in the new Waukesha design of Hesselman engine which was on display in a passenger car outside the hotel after the session.

That there is a real need for a small diesel or semi-diesel for light commercial vehicles was stressed by Rex Wadman, *Diesel Progress*. He feels that the future is bright for the diesel, and commented that in a period of five years Caterpillar had made it difficult to sell gasoline tractors. Will it be hard to sell gasoline engines in another five years? he queried.

Excellence of our gasoline engines and purchaser confusion caused by exaggeration of alleged shortcomings of oil power, are two primary reasons why America has been slow in adopting diesels for highway transport, according to Martin Schreiber of Public Service Coordinated Transport, which operates 154 diesel-powered buses on 10 of its lines. Using a comparable gasoline engine as a yardstick he mentioned, among other factors favoring the oil engine: safety, because of non-inflammable fuel; improved performance, because of better torque; better reliability due to elimination of carburetor, ignition system, and vapor lock; less smoke and exhaust; driver preference, because of more flexibility; simpler maintenance; and greater efficiency in the use of fuel. The first cost is more, but they are worth their price, he declared.

Any extensive use of an oil-burning engine in the light commercial car field will depend upon the development of a motor that is acceptable and usable in passenger cars as well, because the two operations are quite comparable, was a point made by Maurice Walter, Walter Motor Truck Co. It is in the larger truck field where the fuel cost is high that they will have greater acceptance, he said. The relative cost increase in an oil-burning truck unit of these larger sizes, Mr. Walter pointed out, is a matter of 10 or 20%, while in the smaller unit it might easily be 50%.

L. E. Burgess, Mack Mfg. Co., who recently returned from the Southwest, said he had been told that operators in that part of the country are changing gasoline engines to butane or butane-propane burning units at the rate of 2500 per year. These converted units, he said, have the advantages of a throttling engine, of lack of smoke and odor, and of requiring much less maintenance work. Fuel distribution is a drawback, he reported.

In England, where oil-burning engines have made amazing strides, there is no trouble from smoke or bad odor, reported Norman Mitchell, Asiatic Petroleum Co. He sees the future for this type of engine in a different light than does Mr. De Long, he said.

Austin Wolf expressed his opinion that economics will predominate in assigning engines to their proper applications, and his doubt that diesel engines will ever be used in passenger cars. He looks to the oil companies to develop 120 octane gasoline in the not-too-distant future, and asked if we will then want heavy engines. Mr. Wolf, in referring to the diesel-powered buses mentioned by Mr. Schreiber, noted that they are aided by electric transmissions.

In written discussion read by H. H. Allen, Interstate Commerce Commission, T. B. Danckwortt, of Balboa, Calif., said that, in the final solution, the ideal automotive engine will not have cylinder heads, valves, or electric ignition, which are responsible for 25% of the engine breakdowns, but will more probably be a 2-cycle, horizontal, opposed-piston engine.

Utility and Economics of Small Passenger Cars and ½-Ton Trucks **– H. O. MATHEWS, Public Utility Engineering & Service Corp.**

"MOST of the transportation accounting systems which I have seen do not reflect the cost of company-owned garages," remarked Mr. Mathews. "If they did, many companies might soon arrange to dispose of the garage and completely change their garaging routine." Other operating problems covered in his paper are those of personnel require-

ments, driver training, tire and repair maintenance, painting and purchasing practices.

Discussing personnel requirements for the maintenance of these small vehicles, he said: "Experience indicates that one man can maintain, service, wash, grease, and oil about 15 vehicles averaging about 1000 to 1500 miles per vehicle per month, assuming that all of the cars are in the garage every night and that no inspection trips are necessary."

In a review of actual operating costs from several fleets he showed that the depression was instrumental in producing the lowest operating costs, and that increased labor rates and material costs, as well as increases in the prices of vehicles, have contributed to the increases since 1933. He indicated, however, that these increases have been kept to a minimum by good fleet management.

Fleet records also show that 6-ply tires are more economical than 4-ply tires on passenger cars, as they increase mileage about 25% for an 18% increase in cost, he reported.

Commenting on present and future economy models, Mr. Mathews expressed his belief that economy is proportional to the weight regardless of the design, and listed four demands of the operators for future economy: 1. reduced vehicle weight; 2. reduced engine size keeping the horsepower versus weight ratio high enough for good engine efficiency; 3. improved carburetion; and 4. improved ignition.

Discussion

Manufacturers' vehicle-cost-per-mile figures were termed vicious, and any cost-per-mile figure worthless for comparison of different fleets, by T&M men entering the discussion of Vice-President Mathews' paper. They took pot shots at purchasing departments which set aside fleet superintendents' recommendations; debated the optimum number of cars per garage employee; and compared their operating experiences with those reported by the author.

A real need to develop standard practices for fleet operation was expressed by Chairman Preble as he opened the meeting for discussion. He believes that the Society could perform an important service by establishing definite standard practices on such subjects as tire retreading and recapping, painting, load distribution, preventive maintenance, man-power scaling, and effective braking methods. Other discussers added to this list, particularly Capt. O. A. Axelson, Columbia Gas & Electric Corp., who said: "Let us work out a standard for motor vehicle efficiency and forever discard our present inadequate 'cost-per-mile' yardsticks. Let us work out standards for maintenance just as standards have been worked out for production."

The policy of getting bids for new units from competing dealers of the same make of vehicle, was upheld by R. M. Cregar, Public Service Electric & Gas Co., while F. K. Glynn, American Telephone & Telegraph Co., advocated selecting good dealers of several comparable makes to offer bids. This, he feels, results in better public relations for the company. T. C. Smith, of the same company, said in this respect: "If purchasing through competitive bidding is to be fair and really profitable there must be a careful study and comparison of specifications. Certainly the cheapest buy is not necessarily the most suitable or the most economical."

"The matter of selecting vehicles would be greatly facilitated if manufacturers would agree on standard steps for capacity rating and a uniform method of determining the ability rating," declared J. R. North, Commonwealth & Southern Corp.

On the subject of tires, several operators noted that replacement tires do not seem to give as good service as original equipment, and the only explanation offered was that vehicles might not be in as good mechanical condition during the life of the replacement tire. Mr. Smith reported that there are serious efforts under way to provide, at very little extra cost, efficient puncture-sealing tubes, light enough so that they will not generate excessive heat.

Repair practices received considerable attention, particularly preventive maintenance, although John Orr, Equitable Auto Co., pointed out that manufacturers are almost forcing fleet operators back to the "break-down" system of maintenance by making engines hard to get at. Capt. Axelson warned that preventive maintenance can be overdone and urged T&M men to keep in mind that every inspection costs money and that every needless inspection is a waste of money.

While car-dealer free service is not free and is not worth what it costs, in the opinion expressed by Mr. North, Austin M. Wolf, consulting engineer, said in prepared discussion read by the chairman, that in purchasing equipment for New York State full advantage is taken of the dealers' free service, by requiring the manufacturer to guarantee free service by his representatives anywhere within the State.

Mr. Wolf, in further discussion, declared that there is no question about the costly operation of an under-powered vehicle due to almost continuous requirement of full power output as well as excessive gear shifting, because no magic can replace the necessary cubic inches per ton-mile for different terrain and conditions. Much will come from the ideal transmission, once we are nearer its realization, he added.

Concerning Automobile Road Testing – **WILLIAM HARRIGAN, The Texas Co.**

ROAD testing of automobiles, explained Mr. Harrigan, differs from laboratory investigations primarily in that the former discloses a practical consideration of the subject, while the latter is a more or less "hot-house variety" of the same problem – both are essential to one another.

After declaring that the tests under consideration are carried out absolutely independent of sales or advertising departments, Mr. Harrigan gave details of organizing and running the 25,000-mile all-state-capitals road tests conducted by The Texas Co. He explained that, depending upon the recommendation of the management, a fleet consists of from 12 to 16 cars strictly of stock design purchased through new car agencies, and serviced at new car service stations of their respective make during the trip. The 25,000-mile circuit requires four months to complete, including time out for special tests, and costs $240,000, the speaker revealed.

He stressed that the test work is carried on with no attempt to establish the superiority of either cars or petroleum products. "All we are seeking," he stated, "is to find out what happens to automobiles and petroleum products when operated under normal driving conditions in the hands of the public."

The findings are kept absolutely confidential, and duplicates of reports of an individual car are sent only to the chief engineer of the company manufacturing that car, he said. Mr. Harrigan noted that, because of the confidential nature of the test, the crew is selected from company employees who have been with them for at least three years and recommended by three officials of the company.

Before closing, the speaker disclosed some general findings and showed slides of composite temperature data charts. Moving pictures taken on a tour accompanied his paper.

Discussion

Spontaneous discussion, mostly in the form of questions to the author, followed Mr. Harrigan's paper, which had not been available prior to the meeting.

Queried by T. C. Smith, American Telephone & Telegraph Co., Mr. Harrigan reported that, on the recent expedition, gasoline mileage for individual cars ranged from 11 to 22 mpg, and was pretty much dependent upon the size and power of the engine. Oil consumption, he said, was low, ranging from 550 to 1000 miles per qt. Drainage periods were at 1200-1500-mile intervals. He said further, when asked by H. C. Mougey, General Motors Research Laboratories, that oil consumption remained quite constant throughout the trip, except for one car which had to take many more grades in second gear.

Capt. O. A. Axelson, Columbia Gas & Electric Corp., asked if a satisfactory picture resulted from using only one of each make of car. Yes, considering that comments of service men in dealer shops that serviced the car throughout the trip were correlated with the data collected on the tour, was Mr. Harrigan's reply. He added that it would be nice to run more than one car of each make, but that the cost would be prohibitive.

Nine hours was found to be about the limit that a driver

Berger and Chenoweth Receive Manly Memorial Medal

AS authors of the best paper presented before the Society in 1938 relating to theory or practice in the design or construction of, or research on, aeronautic powerplants or their parts or accessories, A. L. Berger, left, and Opie Chenoweth, right, U. S. Army Air Corps, received the Manly Memorial Medal at the May 25 General Session of the SAE World Automotive Engineering Congress in New York.

C. F. Taylor, center, Massachusetts Institute of Technology, made the presentation.

"Supercharger Installation Problems" is the title of the paper for which the Award was made. It was presented before the 1938 Summer Meeting of the Society, and is printed in the Transactions Section of the SAE Journal for November, 1938.

can stand in one day without fatigue reaching the danger point, was the answer to a question by Major M. V. Brunson, U. S. Army. To a question by John R. North, Commonwealth & Southern Corp., the speaker reported that the weight of the vehicle seemed to have no effect upon driver fatigue.

Further information brought out in the discussion revealed that the carburetor jet settings were not altered on the entire trip (except for experimental changes at high altitudes); that oil and lubricants used were of the types recommended by the manufacturers; and that all cars came through in good condition. This latter observation would not have held good three years ago, Mr. Harrigan added.

Diesel-Engine Sessions

Chairmen

F. G. Shoemaker **P. E. Biggar**

That an all-purpose compounded diesel-engine lubricating oil that is non-corrosive to the newer bearing alloys has finally arrived, seemed to be the verdict of an enthusiastic attendance at the first Diesel-Engine Session after hearing over two hours of evidence.

One way of reducing the cost and complexity of injection equipment was suggested in the second session in the form of a single-plunger multicylinder fuel-injection pump. In this final session also, diesel experts and injection-equipment specialists pored over a thoroughgoing analysis of the processes in injection systems.

Recent Developments in Diesel Engine Lubricating Oils **– G. L. NEELY, Standard Oil Co. of Calif.**

A NEW diesel-engine lubricating oil which "contains compounding material of a radically different type; has unequaled anti-ring-sticking value; reduces piston-ring and cylinder wear; prevents lacquer formation; reduces carbonaceous deposits; and yet is non-corrosive to all types of bearing materials," was announced by Mr. Neely. Although specifically recommended for all diesel engines, the new lubricant also may be used in gasoline engines with excellent results, he explained, especially where engine deposits are troublesome.

Tracing the development and background of the new lubricant, Mr. Neely said:

"The research program leading to the development of this product was probably the most extensive diesel-lubricant investigation ever conducted. It included a chemical investigation of the fundamentals of lacquer formation and ring sticking, the construction of a special research laboratory, the design and operation of many special laboratory devices, the preparation of hundreds of chemical compounds, an unprecedented amount of full-scale engine tests in the laboratory and in the field, and the construction of a plant for manufacturing the compounding material selected."

Presenting photographs and charts, he then compared the improved product with straight mineral oils and the "old-style, corrosive-type diesel lubricants." These laboratory tests alone required a total of 26 engines which included 7 makes of diesel engines and a few makes of gasoline engines, he reported.

A fundamental property of lubricants was described which relates to the highest temperature at which an oil will wet a metal surface with a fluid film of sensible thickness. Data were presented showing that engine-scuffing difficulties are prevented by lubricants having good spreading properties at high temperatures. The new lubricant possesses superior spreading characteristics to which its excellent breaking-in and surface conditioning properties are attributed, he contended.

Mr. Neely discussed the comparative economics of engine operation with this new type of lubricant and straight mineral oils. Calculations were included which show a saving in maintenance cost of at least 40% due to reduced engine wear alone. Furthermore, he claimed, the use of this lubricant results in a substantial reduction in oil consumption through freedom of ring action, absence of oil-ring slot clogging, and improved surface conditioning.

Discussion

The importance of the property of "spreadibility" brought out by Mr. Neely was emphasized by C. G. A. Rosen, Caterpillar Tractor Co., who was called to the platform to discuss Mr. Neely's paper from the standpoint of a large diesel-engine manufacturer. Reporting the results of an independent investigation of this property, Mr. Rosen declared that one of the principal factors entering into the control of spreadibility is the control of the flame front. By using this principle in developing a test procedure, he announced that some very interesting results have been obtained in determining the ability of a lubricant to spread over a hot surface.

Congratulations were extended to Mr. Neely for "being the first to offer a non-corrosive all-purpose diesel-engine lubricating oil," by Dr. Ulric B. Bray, Union Oil Co. of Calif., in prepared discussion read by R. E. Rowley, Los Angeles Department of Water & Power, who predicted that this oil "soon will be joined by others of the non-corrosive type." With reference to Mr. Neely's concept, "limiting adhesion temperature," Dr. Bray related that he had found it helpful to resolve this property into two components – oiliness and film strength. "When the property defined as oiliness is combined with film strength," he explained, "provision is then made for the most severe lubricating requirements." Expressing definite disagreement with those who believe that the combination of these two properties is becoming of less importance, he re-emphasized "the importance of film strength in preventing destruction of the frictional surfaces under emergency conditions and the practically continuous function of oiliness agents to reduce wear under normal or mildly severe operating conditions." The use of the type of diesel-engine lubricating oil under discussion in gasoline engines, he contended, results in the deposition of a layer of calcium sulfate in the combustion chamber, and a series of road tests has indicated that this layer of mineral deposits has the effect of raising the octane requirement of the engine by an appreciable amount.

W. M. Holaday, Socony-Vacuum, asked Mr. Neely whether his oil could be reclaimed, and whether it could be used with clay-type filters without clogging. In his opinion the duration of the ring-sticking tests reported should have been closer to 10,000 hr than 1000 hr.

More frequent oil changes may be the solution not only of the problems discussed in this session, but also of the oxidation problem debated in another session, suggested Dr. J. C. Geniesse, Atlantic Refining Co., supporting one of Mr. Neely's recommendations.

The extent of the research reported by Mr. Neely answers the critics of the oil companies who claim that we do little research, pointed out Dr. F. L. Miller, Standard Oil Development Co. He predicted that the final answer on the whole question of lubricants for all engines will be determined more completely as changes in engines are made.

A user of the new oil was next heard from, L. W. Downey, of the Chicago, Rock Island & Pacific Railway Co., who reported enthusiastically on its performance in 1200-hp, 2-cycle diesel engines powering streamliners. In the exacting service demanded in traveling through dirty country, the new oil has given the best results, he said. In the same conditions, he continued, certain oils couldn't operate 16 days without causing the rings and pistons to stick badly but, with the new oil, the rings run free, the piston skirts are clear, the black spots on the cylinder walls are gone. Oil consumption is about the same as with previous oils, he said.

Answering Dr. Bray's contentions on film strength and oiliness, Mr. Neely stated that his formula would have to be, "ask the engine." With reference to Dr. Bray's claims that the oil raises the octane requirement of gasoline engines, he emphasized that "the oil reduces octane requirement as much as any compound that we have added to the crankcase lubricant." The oil can be used in clay filters or any known commercial filter without clogging, he told Mr. Holaday, but it cannot be reclaimed. Supporting Dr. Geniesse, he emphasized: "if the engine says the oil is no good, at least try a shorter change period."

Speaking as Section Chairman and host to be at the conclusion of discussion, Mr. Neely extended the hospitality of the Northern California Section to all who expected to attend the San Francisco Meeting of the SAE World Automotive Engineering Congress and the Golden Gate International Exposition.

Single-Plunger Multicylinder Fuel-Injection Pumps **– TORBJORN DILLSTROM, Hesselman Motors Corp., Sweden**

MR. DILLSTROM explained the operating principles of a single-plunger multicylinder fuel-injection pump, and described how they are carried out in its design. He stressed the simplicity and low cost of having only one plunger, one cam, and one valve delivering fuel to all cylinders up to four, pointing out that two pumps can be used for an 8-cyl engine. He showed how the quantity of fuel delivered to each cylinder can be regulated simply by turning the plunger, and explained the arrangement of overflow and inlet ports. He discussed frankly the specific problems that had to be solved in the development of the pump.

Discussion

Referring to Mr. Dillstrom's statement that compression-ignition engines without injection equipment cost only 8% more than comparable gasoline engines without ignition equipment, to show that most of the difference in the cost of the two complete engines is explained by the cost of the injection equipment, Chairman Biggar commented that the Hesselman pumps seemed to be a definite step forward in the simplification and price reduction of fuel-injection equipment. He also commended the exact workmanship in these pumps which he believes to be as fine as can be found in the world.

Discussion of Mr. Dillstrom's paper was limited to his answering several questions from the floor. To the first he reported that no definite limitation on duration at various speeds of the Hesselman pump had been found. The first pump has run 8000 hr with no trouble from wear to date, he told E. R. Nash of Cousins Tractor Co., adding, however, that dirty fuel will cause the same difficulties as with other injection equipment.

Processes in Injection Systems of Oil Engines **– S. J. DAVIES and EDMUND GIFFEN, King's College, London, England. (Presented by L. C. Lichty, Yale University)**

ALTHOUGH recognizing important contemporary contributions, the authors concentrated on the development of the subject as they have experienced it. The treatment was based on experiments carried out at King's College, London, during nine years, reviewing this development and leading to practical conclusions.

After stating the general conditions affecting injection systems, and in particular the difficulties of small cylinder size, they treated simple systems analytically, and demonstrated experimentally the validity of their treatment, limited, in the first instance, to open nozzles. The variables investigated include pipe length, engine speed, nozzle dimensions, throttle position, and also the viscosity, elasticity and density of fuels. Conclusions are summarized.

The authors next stated the general conditions in the more usual systems embodying spring-loaded nozzle-valves, piping, and special pump delivery valves, and gave a general mathematical treatment of these factors. They also investigated these systems experimentally, and here discussed the effects of the variables: speed, throttle opening, pump delivery valve design, nozzle conditions. They concluded with some deductions of value to engine designers.

Discussion

Four prepared discussions were read. Dr. P. H. Schweitzer, The Pennsylvania State College, and G. W. Baierlein, American Bosch Corp., delivered their remarks in person, whereas the views of E. T. Marsh, National Advisory Committee for Aeronautics, and O. F. Zahn, Jr., were presented by Chairman Biggar in their absence.

Dr. Schweitzer contended that, because of a number of simplifying assumptions, the pressure-wave theory "gives no more than a picture of the injection process, and no quantitatively correct results should be expected." He reported that three of the four assumptions made by the authors had been investigated experimentally at The Pennsylvania State College by recording the pressure surges at two points of a *closed* pipe by oscillographic means. He summarized the results of this work as verifying that a pressure impulse travels with the velocity of about 4800 fps in all large pipes, but up to 20% less in small pipes; that the pressure wave is not reflected instantaneously but "loiters" there for a considerable time; and that the damping of the pressure waves is considerable, depending upon the pipe diameter and the fuel viscosity.

The wealth of experimental work carried out to gain the collective knowledge of the processes in injection systems of oil engines acquired during the past 10 years was possible only through the availability of special devices and accurate instruments, Mr. Baierlein averred. After naming important examples of these instruments, he commented on some of the more important phenomena treated by the authors, including residual pressure, injection lag, pump speed, nozzle opening pressure, nozzle orifice area, diameter and length of discharge tubing, pressure release of the discharge valve, rate of discharge, and fuel viscosity.

The undesirable prolonging of injection after the instantaneous end of delivery of the simple injection system is obtained, as explained, by complete reflection of the pressure wave from the pump plunger, Mr. Marsh said. If, instead of assuming an instantaneous end of delivery, an instantaneous opening of bypass ports, at the pump end, were assumed, he reasoned, the injection process would terminate immediately at the end of the tenth interval; no reflection could occur at the pump end, and a desirable termination of injection would occur.

From the authors' data Mr. Zahn concluded that, to keep the duration within any limits of constancy over the speed range, it is only necessary to use a nozzle of variable area. One of the biggest factors in increasing the speed flexibility of diesels, he said, has been the use of the closed nozzle. There is a limit, however, to the area of even a closed nozzle, he pointed out, because of the throttling of pressure at the valve seat if too much valve action is relied upon to maintain the pressure at low rates of pump delivery. Thus it is today, he continued, that nearly every diesel engine operating over a wide speed range uses not only a closed nozzle, but a closed one with a variable area, except those which do not have combustion chambers that do not use to advantage the single-spray characteristic of all commercially available variable-area nozzles.

"Present-day injection equipment is just an instrument of torture as far as combustion is concerned," maintained Max Fiedler, Fiedler-Sells Corp., "probably because we know nothing about the chemical reactions of hydrocarbons." Recent high-speed photographs of what happens during the time fuel is being injected have shown how little we know, he continued. It is about time, he urged, that we started to investigate what the injection system will look like that will give spray and injection characteristics necessary for good combustion.

Fuels and Lubricants Sessions

Chairmen

T. B. Rendel **T. G. Delbridge**
B. E. Sibley **W. M. Holaday**
A. G. Marshall

That problems involving fuels and lubricants are no respecters of nations was made evident in five crowded Fuels and Lubricants Sessions, where the 10 papers presented with their discussion literally brought a "world of experience" to all in attendance.

A role of increasing importance in the world of tomorrow was predicted for petroleum in a General Session – super fuels, super lubricants, and innumerable new plastics, foods, and fabrics derived from petroleum were envisioned.

Is higher cetane fuel really needed in diesel engines? Will air injection solve problems of diesel roughness? Has the point been reached where additives are essential in diesel engine oil? These and other questions received a sound going over in two of the sessions. In another, the correlation of a number of laboratory lubricating oil tests with service engines was appraised and debated, with emphasis on corrosion and oxidation tests. A number of test methods for rating fuels, developed to eliminate the shortcomings of existing methods, were suggested from at home and abroad at the final session.

Petroleum – Today and Tomorrow **– DR. A. E. DUNSTAN, Anglo-Iranian Oil Co., Ltd.**

DR. DUNSTAN told, from the angle of the petroleum man, how the engine man, and indeed the world at large, is indebted to the natural gift of mineral oil, to the chemists who have somewhat improved upon nature, and to the engineers who have made from it the world's greatest prime mover.

He gave an affirmative answer to the question, "Will posterity have any oil?", estimating that when all the free oil has been taken out of the earth, either by its own pressure or by pumping, there will still be 80% left in the formation – and methods of extracting it will be developed. More accurate methods of refining and fractionation will result in less waste, as have improvements in these methods in the past. Moreover, shale, coal, and petroleum gases offer further sources of liquid fuel, Dr. Dunstan stated.

Super fuels and super lubricants for both spark-ignition and diesel engines were forecast by the speaker, who indicated methods by which they will be developed.

Petroleum's part in the life of tomorrow was visioned by Dr. Dunstan to include further application of carbon black in improving tires and road surfaces; innumerable plastics derived from petroleum as common substitutes for glass, metal, and wood; and even foods, fertilizers, and fabrics derived from petroleum.

Experiments With Doped Fuels for High-Speed Diesel Engines **– J. J. BROEZE and J. O. HINZE, "Delft" Laboratory, Royal Dutch Shell. (Presented by Alfred G. Cattaneo, Shell Development Co.)**

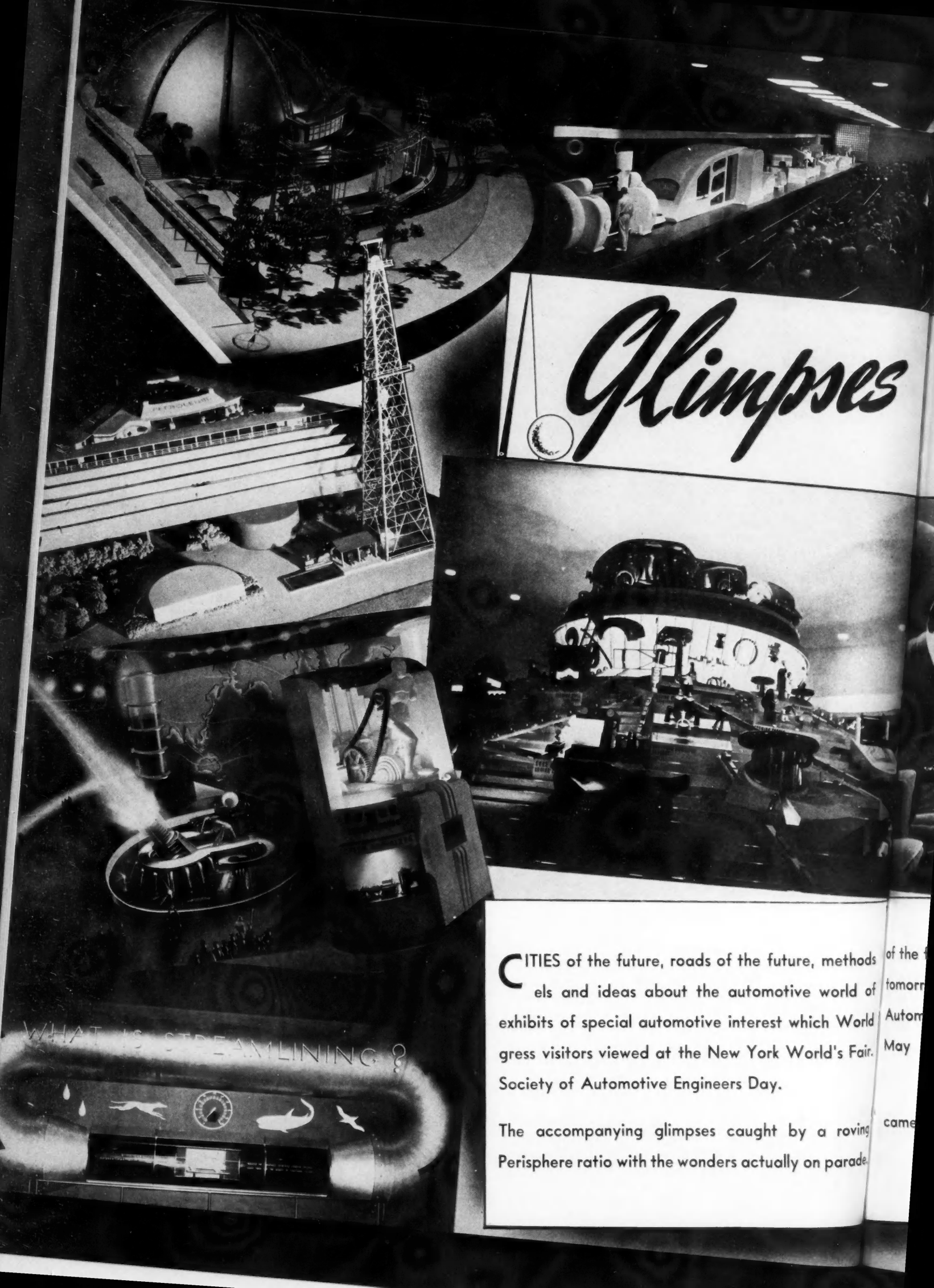
FUELS having low cloud and pour points, but poor ignition quality, may be improved in the latter respect by dopes, for special requirements without unfavorably affecting other properties, the authors announced. The results of experiments with ethyl nitrate and acetone peroxide as dopes were revealed in this paper, mainly with respect to their influence on ignition quality, on the combustion process, on wear (corrosive action), and on incrustrations in the engine. Conclusions reached by the authors include:

The higher the ignition quality of an undoped fuel, the greater the effect expressed in cetane number, but the lower the effect expressed in ignition delay of the dopes considered.

The effect of a dope shows diminishing returns with increasing percentage; is greater in an undoped fuel than in an already doped fuel, both of equal cetane number.

Two fuels of equal cetane number, one being undoped, the other being doped with acetone peroxide, show equal specific fuel consumption, equal maximum output, equal wear and incrustation.

Storage tests during ten months have proved the practical stability at moderate temperature.



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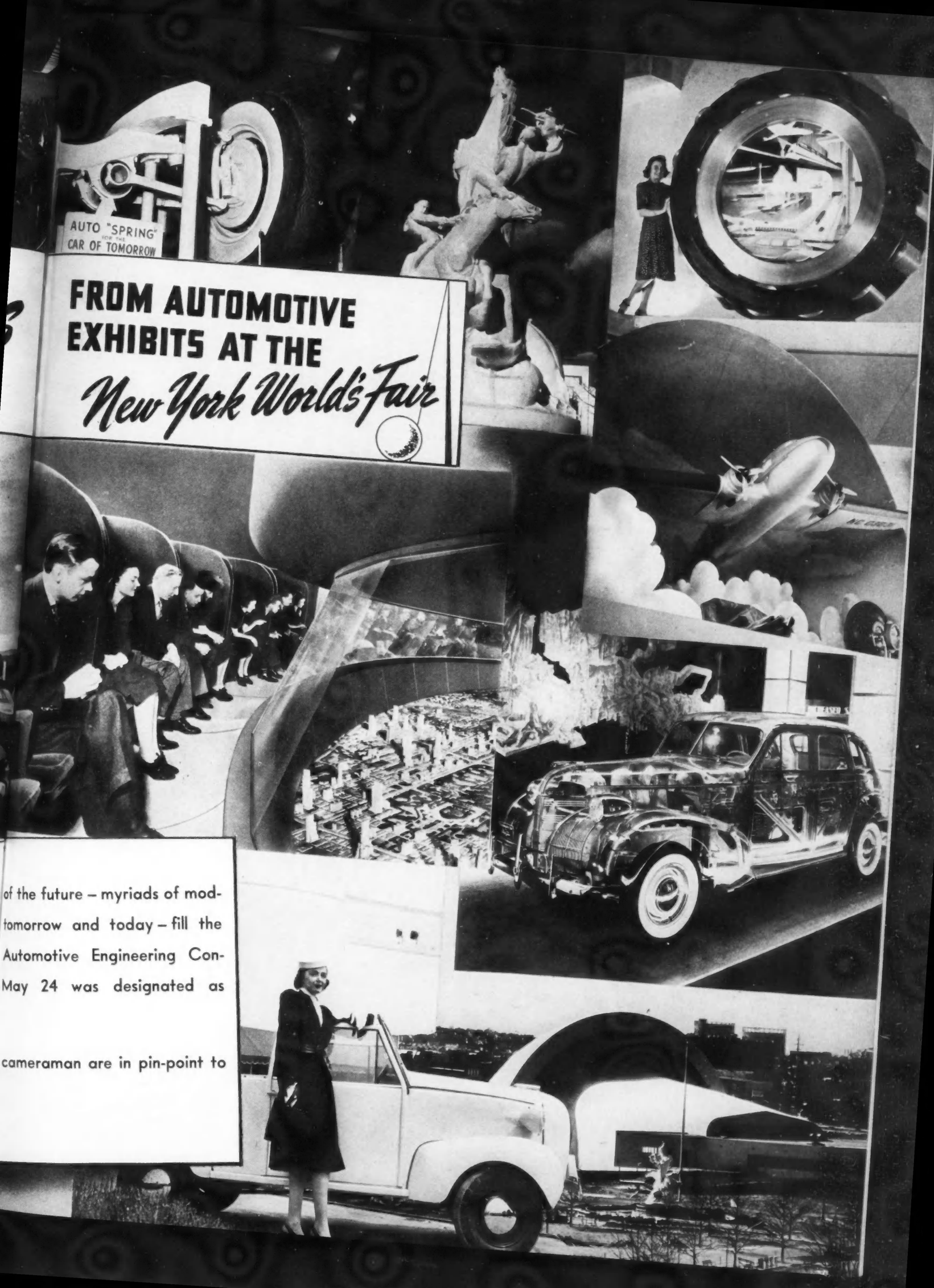

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Discussion

Chairman Rendel opened the discussion by calling on H. V. Nutt, U. S. Naval Engineering Experiment Station, who gave results of tests bearing out the authors' contention that the effect of dope is greater when blended with low ignition quality fuels, in discussion prepared jointly with William F. Joachim. He added that this does not always hold true, and that the characteristics of the base fuel, or as the authors term it, the "chemical activity," has an important bearing on the effectiveness of the dope.

The results of tests on blends of 39 cetane number fuel plus 1.5% of each of the 20 most effective ignition quality dopes investigated, he reported, gave the range in doping effectiveness from 10.4 to 24.7 cetane numbers. Only 3 of the 20 dopes, he added, were shown to be of practical value from the standpoint of having no detrimental effects on the fuel properties.

It is believed that to be of practical benefit, said Mr. Nutt, a dope must increase the ignition quality of a fuel with which it is blended at least 10 cetane numbers for 1% doping and that the cost of doping should not exceed $0.001 per cetane number increase per gallon of fuel. He also gave the result of tests with 59 undoped and 24 doped fuels which show that an increase in the ignition quality of the fuel used, either doped or undoped, results in a linear decrease in specific fuel consumption and maximum cylinder pressure. Other discussers reported an increase in consumption with increase of cetane number.

E. V. Bereslavsky, consulting engineer, who holds patents covering diesel fuels containing amyl nitrates, told the qualities of that dope. He maintained that cracked distillates, as a whole, have a lower pour point and cloud point than straight-run distillates, and therefore can advantageously be used, especially in winter, if their ignition quality is improved by the addition of a dope, to a sufficiently high cetane number, without affecting any other property of the fuel.

He stated that the particular advantages of amyl nitrates, more properly called pentyl nitrates, besides high efficiency, are that this dope is stable in storage and does not lower the flash point below the requirements as, for instance, does ethyl nitrate, so that it can be handled under the same insurance rate and with the same safety in vessels and tank cars as untreated diesel fuel. Acetone peroxide, he added, gradually decomposes in storage.

William H. Hubner, Universal Oil Products Co., entered the discussion at this point reporting tests on straight-run and cracked diesel fuels from five crude-oil sources with three dopes. The cetane-number rating of each fuel was increased by the addition of each dope, with acetone peroxide found to be the most effective, amyl nitrates, next, and ethyl nitrate least, he said. Mr. Hubner also noted that flash point, viscosity, gravity, and initial boiling point were lowered with the addition of both ethyl and amyl nitrates, and that the reduction was considerably less for amyl nitrates. Because of the possible explosion hazard of acetone peroxide, he said, flash point and distillation characteristics of that dope were not determined. Cloud and pour points were reported not affected by any of the dopes tested.

Mr. Hubner also noted that for doped fuels the cetane numbers determined by the critical compression ratio method are appreciably lower than those determined by the delay method, used above.

Cost of dopes came under consideration when C. H. Schlesman, Socony-Vacuum Research Laboratories, said that the addition of 4¢ on a 6¢ per gal fuel is out of proportion, and asked if there is no diesel dope available that can be used with 0.07% concentration as is lead tetra ethyl in gasoline. Mr. Bereslavsky then noted that the cost of adding amyl nitrate is in most cases a fraction of 1¢ per gal.

The question as to whether a cetane race is developing – and whether we really need high cetane numbers, was also raised by Dr. Schlesman. It was Mr. Hubner's opinion that 45 cetane number is high enough with present diesels. However, he put this query – would reduction in compression ratio reduce fuel consumption enough to compensate for the premium price of the fuel required?

That we do not yet know the full significance of cetane numbers, was brought out by G. L. Neely, Standard Oil Co. of Calif., who noted that a method for rating of cetane numbers only recently has been developed. He asked if the industry really wants a high cetane number, and indicated that the oil industry wants to give the diesel manufacturers what they desire. Mr. Neely brought out two points, (1) startability and cetane numbers do not correlate, and (2) that doped fuel is subject to nozzle clogging.

Relation of Diesel Fuel Properties to Their Engine Performance – **W. S. MOUNT and G. A. HOPE, Socony-Vacuum Oil Co., Inc. (Presented by Mr. Mount)**

THAT reasonably good diesel fuel quality pays dividends is indicated by tests covering a good cross-section of present-day engine construction, the authors revealed. Beyond this point, there is little to be gained, they believe, and the most promising means of improving engine performance is in the hands of the engine designer and builder.

The determination of suitable fuel characteristics for the modern high-speed diesel engine, they explained, resolves itself into two basic problems. The first was named as that involving engine life and maintenance costs, both of which are most satisfactorily studied in the field. The second problem is covered in their paper, and deals with engine performance as evidenced immediately after the fuel is put into the engine, they announced.

An attempt was made, they reported, to handle the test equipment in a manner which yields results directly applicable to the customer's problems. The viewpoint, therefore, is that of the fuel supplier and, in analyzing the data obtained, they took care to assign proper weight to the performance improvements obtainable from high-quality fuels as compared to improvements which the engine manufacturer may consider in making minor design alterations.

Discussion

Motion pictures prepared by A. E. Traver and W. C. Hadley of Socony-Vacuum, to record the combustion process as indicated by a cathode-ray oscillograph, were flashed on the screen and explained by Mr. Mount.

C. G. A. Rosen, Caterpillar Tractor Co., asked if some of the roughness noted by the authors might not be traced to hydraulics in the injection systems, and Mr. Mount replied that the injection systems of the engines as they came from builders were used, and that some effects on the cards were traceable to them. Mr. Rosen also stressed that the work done by the oil industry is helpful to the engine manufacturers who strive to use economical fuels and even make design changes to make engines best for locally available fuels.

Almon L. Beall, Wright Aeronautical Corp., asked if air injection would not do much to overcome the difficulties shown by Mr. Mount, and the latter agreed, stating that anything to start fuel burning as soon as possible would be a step in the right direction.

The desirability of burning as much fuel as possible at top dead center was brought out by Dr. G. H. Cloud, Esso Laboratories, Standard Oil Development Co.

Engine Deposits, Field and Laboratory – **J. P. STEWART and B. W. STORY, Socony-Vacuum Oil Co., Inc. (Presented by Mr. Stewart)**

THE transition of oil from its original state to that at which it begins to lay down deposits, is not a single step but rather is a long chain of events and, if the oil is removed before this final state is reached, the deposits would not occur, the authors stated. Laboratory engine tests run to the point of deposition of solid materials, they reported, almost invariably show at first an induction period followed by a relatively uniform increase of insolubles, viscosity, and neutralization number. During this period of the test, they added, no solids appear in the engine. It is after a transition point is reached that the deposition of solids from the

oil onto the engine parts begins. The authors reviewed conventional tests for analysis of the various types of deposits, and their interpretation.

They also pointed out that there is considerable evidence that fuel, as well as oil, plays an important role in at least some lacquer formations. There are other engine deposits, they continued, for which the fuel is partially or wholly responsible that are frequently charged against the oil.

In concluding the authors remarked that the day has come when something must be put into the oil rather than that more be taken out through refining. Furthermore, they added, that "something" which needs to be put in must be better than anything which originally existed in the oil, and "those materials will be products of modern chemical research and will have specific properties and reasons for their being. Much has been done already, but intensive research is being continued and will probably provide most, if not all, of the future improvements in lubricating oils."

Discussion

It became evident that many oil men agree with the authors' contention that we have reached the point where we must add something to oil rather than refine it further, when Chairman Sibley asked for discussion.

The first man called upon, Michel Roegiers, de la Societe des Huiles De Cavel & Roegiers, Belgium, spoke of electrically-treated oils by the Belgium Elektrionic process. A small percentage of this Elektrion concentrate, 5% or 10%, when added to an average or better mineral oil, he stated, results in an increase of the viscosity index, gives the oil anti-sludge properties, protects against lead corrosion, and emulsifies with water. Mr. Roegiers placed on display charts and photographs comparing the condition of engine parts when Elektrion-treated oils and non-treated oils were used.

A warning was sounded by G. L. Neely, Standard Oil Co. of Calif., who reminded the listeners that there is practically nothing one can add to oil that doesn't do something to it and oil men must be certain that they don't add something that does more harm than good. What we need is a balanced product, he declared.

Aviation was represented by Almon L. Beall, Wright Aeronautical Corp., who said that it is still necessary to tear aircraft engines down after a few hundred hours to clean them, even though recommended oils are used, adding that there is not much mechanical damage. This period is set by oil depreciation, he said, expressing his opinion that a great deal can be done on lubricating oils.

R. E. Rowley, of the Los Angeles Department of Water & Power which operates some 1500 vehicles, explained how that fleet makes use of the adverse conditions that develop while engine oil is in use as a source of information for the purpose of controlling operating conditions. He used slides to show how the variations of oil conditions in the fleet are plotted to aid in detecting impending trouble.

Another fleet man, L. R. Gwyn, Jr., Railway Express Agency, in written discussion read by the chairman, said that he feels too much is expected of the oil chemist when he is asked to produce an oil that will give satisfactory results at abnormally low engine temperatures in engines operating under intermittent service. The problem of keeping sump temperatures decently warm, he stated, is one of design, and is by no means insoluble. It would be solved by now if designers were not so busy keeping up with problems arising out of hard continuous operations at extremely high temperatures, he added.

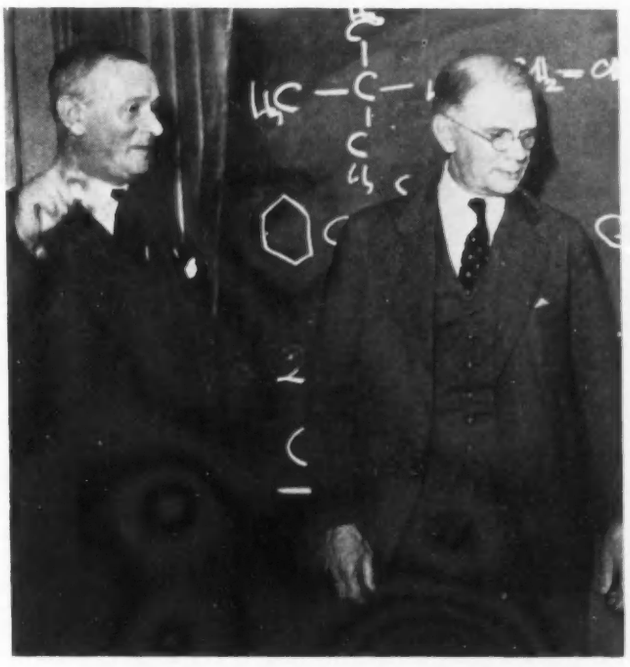
The Testing of Lubricating Oil Stability in Small Engines – **H. A. EVERETT and G. H. KELLER, The Pennsylvania State College. (Presented by Mr. Everett)**

RESULTS of a serious attempt to develop small-engine operating technique to simulate correctly full-size engine action, particularly as regards lubricating-oil punishment, were reported by the authors.

Essential features of the technique were named as a statistical treatment, using six engines, coupled with the determination and control of operative conditions having important influence on the correlation.

Although the carbon-depositing tendencies of an oil usually are not included in the consideration of stability, this characteristic is believed by the authors to have a direct influence on both engine performance and oil deterioration, hence they considered it desirable to develop a method which should coordinate carbon deposition between model and prototype before attempting tests on oil stability in general.

Operating techniques suggested are for predicting the carbon-depositing characteristics, and for determining the change with usage, stability, of lubricating oils for automotive engines.



Dr. A. E. Dunstan, Anglo-Iranian Oil Co., Ltd. (left), telling of the future of petroleum on the opening night in New York, mixed formulas and fun to the delight of his large audience. Dr. T. G. Delbridge, Atlantic Refining Co. (right), presided.

Discussion

Those who have run field tests of motor oils in buses using 50,000-mile increments for each oil tested or have run 500-hr flight tests on aircraft engines can appreciate that small engine testing is intriguing, C. M. Larson, Sinclair Refining Co., said in prepared discussion. Yet, he asked, do we know enough of the factors to be weighed in order to evaluate the lubricant or set-up of the small test procedure? The real problem of small engine testing, he stated, seems to be how to determine the proper head temperatures and the correct oil temperature for a given engine service condition as each make and model varies in service requirements of load, oil temperature, and time factors, not to mention fuel or outside contamination.

W. M. Holaday, Socony-Vacuum, suggested operating the small single-cylinder engines under different conditions to get results similar to actual road conditions. Prof. Everett replied that such tests are under consideration.

In answer to a question raised by Mr. Larson, the speaker said that the little engines give "preview" results. For instance, by tests in these engines unsatisfactory additives can be eliminated, and only the more satisfactory need be tested in full-scale engines, he explained.

Laboratory Tests as a Means of Evaluating Performance of Lubricants – **F. L. MILLER, J. F. KUNC, JR., and R. W. RICHARDSON, Esso Laboratories, Standard Oil Development Co. (Presented by Dr. Miller)**

ALTHOUGH the petroleum industry has expended considerable effort and money in research in order to provide motor oils to meet the expectations of the average motor-oil user, the authors pointed out, this work has been handicapped by the fact that, in most cases, adequate laboratory methods for predicting the different qualities are not available. This condition, they said, makes it necessary to carry out numerous car and engine-performance tests which are both time-consuming and costly,

and makes evident the desirability of simple laboratory procedures which would be used as a means of indicating the probable performance to be expected of oils of different types and character. The purpose of their paper, they announced, is to point out the progress which has been made in the development of laboratory test techniques for evaluating motor-oil quality.

Summarizing the most important of these expected characteristics, they specified that an oil should: show low oil consumption; allow easy starting in cold weather; not form excessive carbon deposits; be free from sludge formation; not stick piston rings; not form varnishes and lacquers; be resistant to corrosion of bearing alloys; and prevent rapid wear of the bearing or rubbing surfaces.

Among the characteristics which may now be predicted to a reasonably accurate degree by laboratory measurements, they named oil consumption, cold-starting, and pumping which are indicated by the viscosity measurements, although noting that volatility may play a role in some cases. As a result of their study of carbon formation, they reported, it appears that volatility tests offer the most promise for their evaluation, and further valuable information might be gained by a fundamental study of the behavior of oils at high temperatures in contact with representative metallic surfaces and in the presence of air and combustion gases.

Underwood Oxidation Test and Its Correlation With Service – **H. C. MOUGEY, Research Laboratories Division, General Motors Corp.**

HIGH crankcase-oil stability, as measured by the Underwood oxidation apparatus, is definitely related to good performance in engines with high crankcase-oil temperature, Mr. Mougey concluded, after presenting test data, correlating Underwood tests on oils and the performance of these oils in engines of different designs under different operating conditions, to back his statement. However, he added, for low crankcase-oil temperature operation or its equivalent, other properties may be the deciding factor.

The Underwood oxidation test, Mr. Mougey explained, was developed by A. F. Underwood to fill the need, in the work of corrosion, for a new test in which the oil would be subjected to the action of air at elevated temperatures in the presence of metals, and to study the effects of catalysts and of inhibitors on the oils under these conditions. For a description of the test, he referred to Mr. Underwood's paper on automotive bearing materials published on pages 385-392 of the September, 1938, SAE Transactions.

We have found from all these data, Mr. Mougey concluded, that, by means of the Underwood test, we can:

1. Test an oil to determine whether or not it will oxidize, and, if it does oxidize, what products, acid, sludge, and so on, will be formed and in what amounts.

2. Determine the amount of inhibitor in an oil by adding measured amounts of a catalyst, and find out how much catalyst is necessary to neutralize the inhibitor in the oil. This determination of the amount of inhibitor in the oil measures the total amount of inhibitor present, but it does not distinguish between inhibitors derived from the crude oil and inhibitors added to the oil.

3. Determine the oxidation characteristics of the oil without inhibitor by adding enough catalyst to counteract the effect of the inhibitor in the oil and then oxidizing the oil. This test indicates the character and amount of oxidation products which may be expected when the oil is oxidized in the engine under conditions where the inhibitor is not effective, for example, on the cylinder walls or in the combustion chamber.

Discussion

The problems discussed have increased in importance with the changing in engine design toward less clearance, higher oil temperature, and lower oil consumption, reasoned B. E. Sibley, Continental Oil Co., the first to read from prepared discussion of Mr. Mougey's paper. A given particle of oil, he continued, is confronted with greatly increased heat over a greater duration of time and spread in a thinner film because of closer clearances. He went on to show that the oil is confronted with conditions of greatly increased severity without relief either from oil in circulation in the engine or by additive oil to the crankcase, thus further accelerating the service and maintenance problems. Draining of crankcases at a reasonable mileage will go a long way in preventing many of these service problems, Mr. Sibley believes. Changing piston clearances 0.001 in. on test engines, he reported, has proved that more frequent changing of the oil on the working surfaces greatly extends the time before lacquering or ring-sticking may be expected. In the endeavor to overcome the varnish and other problems mentioned by Mr. Mougey, he cautioned, we should not lose sight of corrosion problems; an inhibitor that will prevent or minimize the deposition of objectionable material on the working parts would seemingly be satisfactory, provided no corrosion was involved.

A plea for standardization of bearing corrosion tests was voiced by F. L. Garton, Shell Oil Co., Inc., who read from prepared discussion. "A tendency to multiply bearing corrosion tests is evident at the present time," he said, "and, in some cases, wear due to distortion, and so forth, is not distinguished clearly from true corrosion." Stressing the need for correlation among the various interests involved, he contended that "it would be a hopeless situation if we had to have separate tests for corrosion for different engines as, in each case, the same factors are involved." At least it should not be difficult to standardize on one apparatus, he concluded, even if the actual test conditions will need to be varied somewhat for the different cases.

Attention was called by A. W. Burwell, Alox Corp., in prepared discussion read by H. F. Brewer of the same company, to the fact that the six oils tested in the laboratories at the disposal of the SAE Crankcase Oil Stability Committee were rated in the same order as they were rated in the engine tests by the "aniline-point" test. This information, he explained, was contributed by the laboratory of the Sinclair Refining Co., at East Chicago. If more such simple tests are made and correlated, he concluded, it is believed that it eventually will be possible even to predict the lubricating properties of oils.

As an alternative to the development of entirely new tests to measure corrosion of cadmium or copper-lead bearings, modification of the Indiana oxidation test was suggested in a prepared discussion by F. L. Carnahan and C. E. Stevenson of The Pennsylvania State College, read to the session by Prof. H. A. Everett of the same College. Strips of metal may be inserted in the oil being oxidized, they explained, to simulate conditions of engine service or to test the catalytic effect of a given metal; positive or negative catalysts may be added as desired. Advantages of such a procedure, they said, are that the total area of metal is known; the temperature may be controlled closely; and the required time and expense are reasonable. Comparing the Indiana and Underwood tests, they opined that Underwood test data indicate lacquering tendency only as the latter is related to sludge formation, and that the Indiana method is more convenient for the estimation of sludge propensities.

The problem of reproducibility of the Underwood test is not as serious at it appears when plotting from exact values taken at different times, Mr. Mougey contended in answer to the comments of several discussers. He illustrated his point with curves sketched on the blackboard. The analine test, he averred, is related more closely to chemical composition than to engine performance. The reason that we add iron to the oil, he explained, is to find out if it has enough inhibitor in it.

Correlation of the Underwood and Indiana oxidation tests with 1939 6-cyl engine tests operating in heavy, long-distance trucking and also on the dynamometer stand, was reported by C. M. Larson, Sinclair Refining Co., in written discussion. When the five trade-branded oils and three compounded oils were plotted on the rating of Underwood oxidation test and compared with the Indiana sludge time, he related, the order was in reverse – that is, for the highest Indiana time in hours, the Underwood results were extremely high, based on naphtha insoluble, chloroform soluble, viscosity increase, neutralization number, bearing corrosion, and carbon residue. Mr. Larson concluded that there are no trade-branded oils on the market able to cope with the 1½-ton truck carrying 10-ton requirements, and that "the ultimate criterion is not the Underwood or the dynamometer test but the truck or car in John Q. Public's hands."

A modification of the Underwood apparatus developed at

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the Sun Oil Co., was next described by Dr. Andrew Wright of that company, who explained how it was insulated to control the temperature better and how it picks up and sprays the oil. Dr. Wright was introduced by A. L. Clayden, also of Sun Oil Co.

Launching the slogan, "ask the engine," G. L. Neely, Standard Oil Co. of Calif., contended that many difficulties could be avoided if more attention were paid to what the engine had to say. Use laboratory tests, he advised, to check and see if the engine tells the same story twice.

Harold J. Hughes, C. C. Wakefield & Co., Ltd., told why he believed that adding iron naphthenate to determine the effectiveness of an inhibitor is not fair to all types of inhibitors.

Evaluation of the Fuel Test and Proposals for its Formulation – **A. VON PHILIPPOVICH, Deutsche Versuchsanstalt für Luftfahrt, E. V. (Presented by C. B. Veal, SAE research manager)**

THE fuel tests described are to establish the suitability or non-suitability of fuels for all applications, the author explained. The former usual proceeding of simple comparison of antiknock fuels with reference fuels by a single test stipulation, as for instance the octane number rating, is not suitable, he contended. The great circulation which this test and the CFR motor have received, he said, seems to warrant a change at present in the following direction:

1. Rating of octane number and compression-limit according to rules of the ASTM Method, also in addition at 100 and 50 or 30 C (mixed temperature).

2. Determination of the mean operating temperatures in the usual engines with uniform procedure.

The research on lubricating oils has been carried out with great diversity until now. As it was apparent that one of the main characteristics of lubricating oil – the ring-sticking period – of the various oils, was dependent in various ways on the test temperature, he showed that diagrams had to be established for this value. The practical main value for a given engine according to its mean piston temperature must then be read from the point where this temperature is registered, he explained.

Discussion

Chairman Marshall opened debate by reading a prepared discussion submitted by Robert F. Selden, National Advisory Committee for Aeronautics. As there is yet no indication that full-scale engine operating conditions will become standardized in the immediate future, Mr. Selden reasoned, it is necessary to rate engines as well as fuels as the author points out. Otherwise, he added, the existing expedient of determining the fuel requirements of each engine type is the only alternative. He contended that this, in effect, is one method of rating engines, "whether engine manufacturers wish to admit it or not." If one is to trust the author's data on lubricating oil, Mr. Selden concluded, one must recognize the futility of rating oils at a single engine operating condition.

"The situation is much less confused than the author's pessimism would lead one to believe," contended A. L. Beall, Wright Aeronautical Corp. For the moment, the CFR Motor Method is employed in this Country for aviation fuels, he explained, with a full knowledge of its shortcomings and with other limitations incorporated in the fuel specifications to support the weakness of the method. Much of the work proposed by Dr. Phillipovich is under way or projected in the CFR Committee, except selection in absolute terms of the method to be adopted finally for the laboratory determination of knock value, Mr. Beall revealed.

The necessity for a family of temperature curves would seem to make the author's recommendations just as complex as present methods, contributed M. S. Kuhring, National Research Council of Canada.

A New Laboratory Method for Rating Aviation Fuels of High Octane Number – **R. STANSFIELD and H. B. TAYLOR, Anglo-Iranian Oil Co. (Presented by T. B. Rendel)**

THE new laboratory method for rating aviation fuels introduced in their paper was developed, the authors announced, in an attempt to improve correlation with full-scale aero-engine behavior, especially for fuels of high octane number. They explained that the new method uses a cathode-ray oscillograph and an indicating unit showing rate of change of pressure diagrams, and that, as the measure of knock, the height of the first wave of the detonation is employed. In making the test, they continued, the maximum observed height in a minute is recorded, and the mean of three such observations gives the required knock intensity.

The development work leading to the method, they reported, was based on two premises: first, that any fuel must exceed a definite minimum antiknock value appropriate for its class when used under lean-mixture cruising conditions; and, second, that it must exceed a second minimum when used under rich conditions appropriate for take-off, the two minima not necessarily being the same in terms of the reference fuels adopted.

Modifications made to the test engine to simulate an aero-engine cylinder more closely, they related, include altering cylinder dimensions to permit an aluminum piston to be used at high rotational speeds and provision for supercharging.

The proposed method is not assumed to reproduce actual engine conditions, the authors qualified, but is a laboratory device which makes use of an existing engine with only simple modifications and easily obtained instrumentation. No claim is made that it can be extended further than to obtain suitable correlation with aero-engine fuel ratings under cruising and take-off conditions, they concluded.

Discussion

A method that can be used by aircraft-engine manufacturers to rate fuels is in prospect before the end of the year, according to T. B. Rendel, Shell Oil Co., Inc., who discussed the work of the CFR Laboratory Detonation Project. However, he qualified, it will not rate an experimental fuel in an experimental engine. We all recognize the possibility of using different mixture ratios than those we now use, and that present test methods give unsatisfactory reproducibility around and above 100 octane number, he explained. He then told what had been done to improve the reproducibility and sensitivity of these methods. "The trouble with both the Motor and Air Corps Methods is that we haven't been observing enough phenomena," maintained Robert V. Kerley, U. S. Army Air Corps. Employing information obtained by Phillips Petroleum Corp., he explained how as much sensitivity as desired can be obtained regardless of octane number, without too much change in laboratory equipment.

As, with the modern aircraft engine, the degree of sensitivity to knock does not vary greatly between lean and take-off mixtures, Mr. Beall contended, the new method proposed by the authors would tend to double the amount of testing work without producing any more useful results.

Fundamental Mechanical Aspects of Boundary Lubrication – **H. BLOK, "Delft" Laboratory, Royal Dutch Shell. (Presented by Alfred G. Cattaneo, Shell Development Co.)**

AMONG the lubrication problems encountered under the more and more exacting service conditions of today (for example, increased engine performance and hypoid gears), the problem of boundary lubrication is attracting ever-increasing attention, Mr. Blok pointed out. From the physico-chemical side, he said that boundary lubrication already has been investigated fairly thoroughly. But, he remarked, a great obstacle in the intelligent selection of lubricants and materials is that the physico-

chemical results cannot be exploited to the full without knowing the fundamental mechanical aspects, therefore he first discussed data on this missing link.

Starting from the thesis that pressure and temperature in the region of contact between the rubbing surfaces are the basic mechanical factors, he showed that four main types of boundary lubrication should be distinguished:

1. Low-pressure and -temperature boundary lubrication; briefly, mild boundary lubrication.
2. High-temperature boundary lubrication.
3. High-pressure boundary lubrication.
4. High-pressure and -temperature boundary lubrication; briefly, extreme boundary lubrication.

Up to now, Mr. Blok said, Type 4 has been called: "extreme-pressure lubrication," but, logically, the term now proposed should be adopted, as in this region of boundary lubrication it is more the extreme-temperatures (for example, temperature flashes on gear teeth) than the extreme pressures, that are decisive. Moreover, he added, confusion with the high-pressure boundary lubrication (Type 3) can then be avoided.

Phenomena, characteristic for each of the four main types of boundary lubrication, were discussed by the author and frictional (that is, tangential) vibrations of rubbing surfaces are referred to.

Discussion

A telegram from Mayo D. Hersey, Kingsberry Machine Works, "reporting substantial agreement with the mechanical point of view outlined by the author," but pointing out that "boundary lubrication is usually mixed up with some degree of fluid lubrication," was read by Chairman Marshall to start off discussion of Mr. Blok's paper.

Results of experiments during which the performance of bearings operating under boundary conditions was investigated, were summarized by L. M. Tichvinsky, Westinghouse Electric & Mfg. Co., in prepared discussion also read by the Chairman. He showed that accurate measurements of the surface finish of the sliding elements are very useful. As would be expected, he reported, the hardest of three kinds of journal materials performed at the lowest friction and, at the low loads used, the surface underwent some change for the softer materials and none for the hardest one.

The hope that the author can present test results in the various classifications to support their establishment was voiced by Mr. Beall.

Agreement "with everything the author says," was expressed by Prof. H. A. Everett, The Pennsylvania State College, with the reservation that we seldom run into cases of lubrication that are so simple and can be segregated and classified as one of these types. An additional property for lubricating oils would be helpful, he pointed out – an amplification of the viscosity index which takes into consideration both the effects of temperature and pressure.

Agreement also was indicated by Dr. O. C. Bridgeman, National Bureau of Standards, on the basis of work on boundary lubrication done at the Bureau, and by Dr. J. C. Geniesse, Atlantic Refining Co., who added that the material will be useful to a subcommittee of the American Standards Association which now is working on terms for the various classifications.

Although it is true that chromium cylinder walls and pistons can be very hard, contended H. van der Horst, Lemet Chromium, Holland, I do not think that hardness is the reason for its resistance to wear. He announced that he was planning tests at Delft on cylinder bores with a few thousandths of gold deposited on their surfaces.

Hypoid lubricants have not been giving as good service on trucks as on passenger cars, revealed H. C. Mougey, General Motors Corp., injecting a commercial problem into the discussion. To close the session, J. B. Fisher, Waukesha Motor Co., told of conditions in engine bearings and crankshafts that bring about localized loads.

INDIANAPOLIS

A LIVING story of the Indianapolis Speedway and the engineers whose products have made racing and technical history there was brought to the SAE World Automotive Engineering Congress by D. G. Roos, vice-president in charge of engineering, Willys-Overland Motors, Inc., when he spoke at the Congress Banquet in Indianapolis on May 29. Mr. Roos paid tribute to engineering and experimental geniuses associated with racing, and spoke of the late Fred S. Duesenberg as an outstanding example of the group whose race car design achievements have helped materially toward the comfortable and safe passenger cars of today.

Mr. Roos was introduced by Toastmaster Capt. E. V. Rickenbacker, president, Eastern Air Lines and head of the Indianapolis Speedway Corp. About 250 members and guests were in attendance.

The banquet was opened by Col. A. W. S. Herrington, presiding in place of Indiana Section Chairman Macy O. Teetor, who was in the hospital recovering from an appendix operation.

Racing Lessons Important, Roos Says

"Super-highways of the future," Mr. Roos predicted, "will bring the problem of the passenger car engineer always closer to that of the racing car designer. It is inevitable that this be so because the history of the human race has been a quest for constantly growing speeds."

He voiced his astonishment that "the automotive engineering profession in this Country, as a whole, knows so little about what these race cars actually are and do. It seems unbelievable," he added, "that the winning car is not bought by some large company every year and tested completely on block and chassis dynamometer so that the actual performance and design constants throughout are ascertained. Such a policy would not only stimulate design, but would be insurance for meeting future requirements."

Comparing the 1908 Vanderbilt Cup winner with the typical 183 cu in. supercharged job of today, he stated, "we are getting 13.2 times as much power per cubic inch as in 1908; we turn the engine 5.38 times as fast; the cars are at least 50 to 60 mph faster at top speed; and they go nearly three times as far on a gallon of gasoline."

Among the advances to be credited to the race track, Mr. Roos listed the modern lubrication system, development and testing out of mineral and compounded oils capable of standing high bearing loads and temperatures without breaking down, reduction in displacement of engines, tremendous improvement of piston-ring design, better tires, and remarkably dependable spark plugs; plus added knowledge on bearing materials, cam and valve-gear construction, valve material, and streamlining. The supercharger and the problem of its drive had its development at the Indianapolis race, he added.

The race tracks, Mr. Roos predicted, will help solve some of the industry's most controversial problems. They will contribute to the decision between front-wheel, rear-wheel, and

four-wheel drive; 4, 6 and 8-cyl; supercharged and non-supercharged engines; and engine in the front and in the rear.

When the Congress visitors arrived in Indianapolis on May 29, they were met by an Indiana Section reception Committee headed by Lee Oldfield and by incoming Indiana Section Chairman A. L. McCollum.

The guests were then taken in private automobiles to their hotel, attended an Aviation Luncheon at the Indianapolis Athletic Club in honor of the dedication of the C.A.A. Radio Research Laboratory at the Indianapolis Airport, and, in the afternoon, visited the Indianapolis Speedway. There they inspected the garages where the cars were being prepared for the Memorial Day Race, talked with drivers and mechanics and were personally welcomed by Capt. Rickenbacker and T. E. Myers, the Speedway's general manager.

On Memorial Day, the Congress visitors saw Wilbur Shaw win the 500-mile Memorial Day Race and later entrained for Detroit where the next Congress activities were scheduled.

DETROIT

The Congress group which was entertained at Greenfield Village and the Ford factories.

ARRIVAL of the touring WAEC delegates at the automotive capital during a week when a national holiday and a body plant strike had combined to close many factories failed to upset plans for a well-rounded program in Detroit. Comparatively minor changes in the schedule enabled the Detroit Section committee under SAE Vice-President W. B. Hurley to steer the visitors on inspection trips through a variety of plants and laboratories where the guests were met and welcomed by leaders of the industry.

In addition to the plant tours, the visitors took part in one important technical session which dealt with metallurgy and were guests at a banquet at Hotel Statler. Here K. T. Keller, president of Chrysler Corp., serving as toastmaster, introduced W. S. Knudsen, president of General Motors Corp., who delivered the principal address of the three-day stay in Detroit.

The Detroit phase of the transcontinental engineering meeting covered the three days spent viewing the activities of Ford Motor Co., Chrysler Corp., and General Motors Corp., respectively. In those three days many feet crossed thresholds where doors are ordinarily locked to outsiders, and strangers' eyes saw sights and tests which usually are very secret. All in all, it was probably the biggest "open house" ever staged in the auto industry.

Ford

Henry Ford's Greenfield Village and Dearborn Museum were the centers of interest the first morning, Wednesday, May 31. Luncheon was provided, as it was on each of the three days, and at Dearborn Inn the guests were welcomed in the names of Henry Ford and Edsel Ford by A. G. Colton, of the Ford Motor Co. Then there was an opportunity to inspect the Ford Rotunda and ride around the grounds on the historic sections of roadways from all over the world. While many major units of the Ford Rouge plant were "down" during the holiday week, opportunity was provided for close inspection of operations in the new Ford tire plant and in the Rouge glass plant, and the party's buses encircled most of the Rouge operations and factories.

Chrysler

In lieu of visiting the Plymouth plant – closed by lack of auto bodies when Briggs Mfg. Co. suffered a strike – the Congress group went to the Chrysler Jefferson Avenue plant and its production research laboratory. D. A. Wallace, president, Chrysler Sales Division, and sponsor of the Superfinish process, addressed the group and demonstrated and explained the nature of that process. Then, northward across the city, buses transported the engineers to the new Dodge truck plant, noted as one of the most modern of industrial structures and probably the largest truck assembly plant in the world.

Chrysler executives welcomed the group at lunch at the Highland Park administration building, after which the engineering research laboratories were thrown open. The entire afternoon was spent in this section, with students from the Chrysler Institute of Engineering acting as guides, and members of the engineering staff willingly answering questions.

General Motors

As if to get in trim for the long overland journey to the Coast, the visitors made a trek to Milford, Mich., on Friday to inspect the General Motors Proving Ground. Here, again, many of the strict rules of secrecy were waived. The Congress group was escorted through the various laboratories housed at the site and rode over the intricate highway and road system on the 1300-acre outdoor test range.

In the Proving Ground auditorium, Ernest F. Davis, Warner Gear Division of Borg-Warner Corp., addressed about one hundred engineers on "What Is New in Heat Treating Methods, Materials and Processes," and Enrique Touceda, con-

The SAE Journal appreciates deeply the cooperation of Ford, Chrysler and General Motors (Chevrolet Division) which provided the interesting photographs accompanying this story of the Detroit phase of the Congress.

1. O. E. Hunt, vice-president, General Motors Corp., describes Proving Ground contours to a part of the Congress group.

2. K. T. Keller, president, Chrysler Corp., welcomed the Congress group at luncheon during an inspection trip of Chrysler plants. At his side was B. E. Hutchinson, Chrysler vice-president and finance committee chairman.

3. SAE Past-President Harry T. Woolson, Chrysler executive engineer, played a prominent part in entertaining the Congress at Chrysler.

4. SAE Secretary and General Manager John A. C. Warner (left) and Ralph R. Teetor, SAE Meetings Committee chairman (center), inspect a fifth wheel speedometer at General Motors Proving Ground with W. H. Holt, Chevrolet (right).

5. A part of the Congress group inside the big Ford glass plant at River Rouge.

sulting engineer, and J. H. Lansing, shop practice engineer, respectively, for the Malleable Founders Society, Cleveland, spoke on "Developments in Malleable Iron Practice and Their Automotive Applications." Following are digests of these papers:

Production Session

A. J. Schamehorn, *chairman*

Developments in Malleable-Iron Practice and Their Automotive Applications – **ENRIQUE TOUCEDA and J. H. LANSING, Malleable Founders' Society, Cleveland, O.**

A MATERIAL that is able to withstand shocks, possesses adequate stiffness, is cast and cored to eliminate excess weight and finishing operations, and yet machines with exceptional facility, may be, and is, utilized to decided advantage in automotive service, the authors pointed out. With such a material, malleable iron, their paper dealt. The major steps in the process, melting and annealing, were described, and developments in, and various types of, annealing equipment were considered.

The metallurgical considerations involved first the production of the original white-iron castings made up of the two structural elements, free cementite and pearlite. In the annealing process they told how their structural composition is changed completely; how the free cementite and pearlite are converted into the structural element silico-ferrite which is tough, strong, and ductile. The carbon originally present in the cementite and pearlite has been precipitated in the form of temper carbon and appears as soft nodules, distributed throughout the matrix of ferrite, they explained. Modifications of normal malleable, known as pearlitic malleable, were mentioned. Such castings, they said, find use where wearing properties, accompanied by a reasonable amount of toughness, are in demand. In this case the metallurgical process is such as to produce a matrix of silico-ferrite and pearlite, sorbite or spheroidized cementite.

Improvements in the industry were indicated by progressive advancement in physical properties. Since 1915 the ASTM specifications have increased from the 38,000 lb per sq in. ultimate strength and 5% elongation, to the current values for two grades as follows: Grade 32510, ultimate strength 50,000 lb per sq in., yield point 32,500 lb per sq in.,

elongation 10%; Grade 35018, ultimate strength 53,000 lb per sq in., yield point 35,000 lb per sq in., elongation 18%. The importance of design and the value of designer-foundry cooperation were stressed. Suggested factors worthy of consideration in connection with the design of cast parts were outlined.

The development of a shock-resistant structure was illustrated by views of fracture, structure, and castings subjected to severe impact. Machining illustrations demonstrated the facility with which malleable-iron castings may be machined. Automotive applications were illustrated in chassis and individual views. The diverse use in truck and tractor construction, as well as in passenger car parts, was shown. Some pearlitic malleable uses were included. The use of the normal product in railroad, agricultural, electrical and other fields was illustrated. As a concluding illustration, the possibilities of swivel castings were demonstrated.

What Is New in Heat-Treating Methods, Materials and Processes – **E. F. DAVIS, Warner Gear Division, Borg-Warner Corp.**

THE control of grain size has facilitated the development of new steels and modifications in heat-treating processes, Mr. Davis announced. His paper dealt with modern progress in the steel mill, the employment of the Carbometer and Turbidimeter, lime-silica ratio and the newer deoxidizers employed to aid steel quality. The internally heated immersion bath has been a distinct advancement in salt-bath hardening and enables longer pots to be practical, he explained. Dry cyaniding with ammonia gas may eventually obsolete cyanides and activated baths, in the opinion of the author. Gas carburizing gradually is supplanting box carburizing, he reported, and many large heat-treating units carburize, quench wash and temper mechanically. Also, a late gas carburizing furnace eliminates the employment of a muffle. The principle of tube combustion or radiant heating, he related, is being used extensively in atmosphere-controlled furnaces for sheet and strip annealing, furnaces for short-cycle malleable annealing, and other heat-treating applications. He prognosticated the future possibilities of induction hardening, and outlined the present status of its development.

Knudsen Speaks Frankly

Declaring that the superiority of the American automobile is recognized in other countries, and that sales are limited only by the artificial barriers set up against importation of American cars, Mr. Knudsen, in his banquet speech, placed on engineers the obligation to carry on in this forward position. Complimentary about achievements in performance, he was critical about some outstanding points.

"There are possibilities of still further progress in the improvement of carburetors that will handle fuel economically without being subject to too-narrow adjustment variations – in other words, simple carburetion," he said.

"The interiors of our cars are the envy generally of foreign manufacturers," he went on, "but even here it seems to me that we could devise simpler means of accomplishing some of the functions first. Rubber cushions show some promise, and I feel that window regulators could be made much more efficient and consequently lower in cost. The formidable array of buttons on the dash could also be, in my mind, redesigned to reduce the number and the cost; and both the radio and the heater are too bulky and too expensive. The development of accessories has shown very good progress but I am sorry to say that the overall cost of complete accessory equipment for a car is out of all proportion to the cost of the car itself."

Coming to what he termed a "forward program in automobile engineering," Mr. Knudsen predicted independently sprung rear axles in the near future; said a way could be found to combine the body underpan with the frame in one piece and accomplish substantial weight-saving without any great sacrifice in structural strength; pointed to the definite trend toward overdrive transmissions; and said the fluid flywheel is just a question of cost. He called attention also to the excellent progress in headlight development which is being made possible by the cooperative efforts of all the engineers and the vehicle commissioners.

Of business in general, Mr. Knudsen declared that while our distribution system today is in a somewhat confused state, there is every reason to believe that, despite political handicaps, things will straighten out and business will get better. He based this on the conviction "that the trend of thinking is slowly but surely turning towards the right, and the attempts of regimentation which constantly bob up in one way or another are getting more and more unpopular."

SAE *Coming* EVENTS

National Tractor Meeting
Sept. 28-29 Milwaukee, Wis.
Hotel Schroeder

National Aircraft Production Meeting
Oct. 5-7 Los Angeles

National Transportation & Maintenance Meeting
Oct. 26-27 St. Louis, Mo.
Coronado Hotel

National Fuels & Lubricants Meeting
Nov. 2-3 Tulsa, Okla.
Mayo Hotel

Annual Dinner
Oct. 16 New York
Hotel Pennsylvania

Annual Meeting
and Engineering Display
Jan. 15-19, 1940 Detroit
Book-Cadillac Hotel

About SAE Members:

ODBERT P. WILSON, recently was named president and treasurer of the Norma-Hoffmann Bearings Corp., Stamford, Conn., succeeding **WALTER M. NONES,** who became chairman of the board. **H. J. RITTER** was elected vice-president and continues as secretary and sales manager. Mr. Nones had been president of the company for 28 years. Mr. Wilson was executive vice-president and treasurer of the company before being elected president.

ALBERT R. CROCKER, Pratt & Whitney Aircraft Co., has been made experimental test engineer. He was production engine tester.

RALPH S. JOHNSON, formerly test pilot for United Air Lines Transport Corp., Cheyenne, Wyo., has joined Douglas Aircraft Co., Inc., Santa Monica, Calif., in the same capacity.

CAPT. SAMUEL VANCE KRAUTHOFF, Field Artillery, United States Army, has been transferred from Fort Leavenworth, Kan., to Fort Bragg, N. C.

J. W. SHIELDS, manager, farm tire department, United States Rubber Co., has been transferred from New York to Detroit.

FLOYD KISHLINE has become assistant engineer of Nash-Kelvinator Corp., Kenosha, Wis. He goes to Nash from Willys-Overland where he held the post of assistant chief engineer. Before that he was chief engineer of Graham-Paige for many years. Mr. Kishline was chairman of the Detroit Section in 1938 and a vice-president of the Society in 1934. He is a member of the SAE Passenger Car Activity Committee, the General Research Committee, several fuels research committees, the Sections Committee, and is vice-chairman of the passenger car division of the Standards Committee.

Floyd Kishline
Joins Nash

W. S. JOHNSTON, who was the Marmon and Pierce-Arrow dealer in Trenton, N. J., for many years, has been appointed the Trenton Cadillac-LaSalle distributor.

L. P. SAUNDERS has been elected president of the Western New York Chapter of the American Society of Heating & Ventilating Engineers for the 1939-1940 season. Mr. Saunders is chief engineer, research division, Harrison Radiator Division of General Motors Corp.

COL. BURTON O. LEWIS, Ordnance Department, United States Army, is stationed at Aberdeen Proving Ground, Md.

SAE men were prominent among those discussing automotive topics at the recent mid-year meeting of the American Petroleum Institute at New Orleans. Among those on the program were: **C. W. PHELPS,** consulting engineer; **L. C. LICHTY,** Yale University; **HERSCHEL G. SMITH,** Gulf Oil Corp.; **J. B. MACAULEY, JR.,** Chrysler Corp.; and **S. D. HERON,** Ethyl Gasoline Corp.

Both the Stevens Institute of Technology and the University of Detroit honored **WILLIAM S. KNUDSEN,** president of General Motors Corp., by awarding him honorary Doctor of Engineering degrees last month. As commencement speaker at Stevens, Mr. Knudsen expressed his faith that "young men have a greater opportunity today than they ever had before, because the development within this country during the next 50 years is not going backward, or even standing still, but just naturally has to go forward in greater strides."

W. S. Knudsen
Twice Honored

An honorary Doctor of Engineering degree was awarded to **GLENN L. MARTIN,** president of The Glenn L. Martin Co., Baltimore, by the University of Maryland at its commencement, last month. Dean S. S. Steinberg of the College of Engineering, in presenting Mr. Martin for the degree said: "Among the many marvels of our age, the one which has given man the greatest mobility is human flight. There is a pioneer in aviation, resident of Maryland, who continues to advance aeronautical science by designing newer, swifter, and more efficient airplanes."

S. A. STRICKLAND, president of Bower Roller Bearing Co., Detroit, has been elected a director of the Union Guardian Trust Co. of the same city.

WALTER A. HAMILTON, long system maintenance superintendent, Transcontinental & Western Air, Inc., Kansas City, Mo., has joined the executive staff of the Douglas Aircraft Co., Santa Monica, Calif.

W. A. Hamilton
To Douglas

F. W. GURNEY, chairman, Marlin-Rockwell Corp., recently returned from a 5-month cruise around the world on the steamer *Franconia.*

DR. PER K. FROLICH, director of chemical laboratories, Standard Oil Development Co., discussed manufacture of synthetic products from petroleum, at two meetings of the department of manufacture of the National Petroleum Association at Olean, N. Y., last month.

A. W. HOPTON, general sales manager, tire sales division, Dominion Rubber Co., Ltd., Montreal, has been appointed a vice-president of the company. Mr. Hopton has been affiliated with the organization since 1916.

DALE E. COOPER, a recent graduate of Tri-State Engineering College, is employed in the engineering research department, Beacon research laboratories, The Texas Co.

GERARD SUDA is senior engineering draftsman with the United States Navy at the Brooklyn Navy Yard. He formerly was with the International-Plainfield Motor Co., Plainfield, N. J.

ROBERT G. N. EVANS has opened offices as consultant on sleeve bearings, non-ferrous metals, surfaces, and lubrication technology at 2951 Downer Ave., Milwaukee. He formerly was engineer in charge of research for Bunting Brass & Bronze Co., Toledo.

LEIGHTON W. ROGERS, former president of the Aeronautical Chamber of Commerce of America, has been elected vice-president of the Bellanca Aircraft Corp., New Castle, Del. Mr. Rogers was commercial attache of the Department of Commerce for many years, and organized the Aeronautics Trade Division of that Department.

L. W. Rogers
Bellanca
Vice-President

At the 41st annual meeting of the National Metal Trades Association, **ARTHUR H. TIMMERMAN,** vice-president in charge of engineering, Wagner Electric Corp., was re-elected first vice-president; **H. FOLLETT HODGKINS,** president, W. C. Lipe, Inc., was elected to the council for two years; and **H. H. KERR,** president, Boston Gear Works, Inc., was elected to the council for one year. **JULIUS P. HEIL,** Governor of Wisconsin and president of the Heil Co., gave the feature address.

B. M. CRAIG is affiliated with the California Institute of Technology, chemistry department, Pasadena, Calif., as instrument designer. He is engaged in developing an harmonic analyzer calculating machine for rapidly evaluating Fourier series such as are encountered in X-ray crystal structure study.

HENRY FLOOD, JR., is president of Murray & Flood, Inc., professional engineering, New York. He was executive vice-president of the Devonshire Corp., of the same city.

CARL B. SQUIER, vice-president and sales manager, Lockheed Aircraft Corp., Burbank, Calif., made a recent demonstration flight to Latin America with the new Lockheed 14.

T. P. WRIGHT, vice-president and director of engineering, Curtiss-Wright Corp., in "America's Answer," an article appearing in the June, 1939, issue of *Aviation,* writes on gearing our aviation industry to the national defense.

BRUCE K. CRAIG, formerly engineer with American Airlines, Inc., Chicago, is now with Consolidated Aircraft Corp., San Diego.

C. FREDERICK WOLCOTT is chief television engineer, Gilfillan Bros., Inc., Los Angeles. He was formerly in charge of radio engineering, T. L. Siebenthaler Mfg. Co., Kansas City, Mo.

DR. GEORGE W. LEWIS, director, aeronautical research, National Advisory Committee for Aeronautics, and **MAJ. LESTER D. GARDNER,** secretary, Institute of the Aeronautical Sciences, attended the annual meeting of the Royal Aeronautical Society, London, last month. Dr. Lewis delivered the Wilbur Wright Memorial Lecture and Major Gardner was awarded an honorary fellowship in the Society.

F. K. WHITBURN, who has been secretary to plant manager, Chevrolet-Oakland Division of General Motors Corp., recently was appointed time study engineer for the division.

E. C. SULZMAN, field engineer, Wright Aeronautical Corp., Paterson, N. J., has been transferred to the company's West Coast office at Los Angeles.

E. W. McKAY has been transferred from Pittsburgh to Philadelphia by the Bendix-Westinghouse Automotive Air Brake Co.

JOHN M. WETZLER, JR., after receiving his Bachelor of Engineering degree from Johns Hopkins University, last month, started work at General Motors Proving Ground, Milford, Mich.

E. J. Bryant
Whose appointment as western district sales manager of Greenfield Tap & Die Corp. was noted last month

SAMUEL L. BOUKARD has been named a director of Pacific Aviation, Inc., a new company which will manufacture radio and transmitting equipment and other aeronautical equipment. A factory site has been leased at Los Angeles Municipal Airport.

The appointment of **L. D. BOYCE** as a member of the Cooperative Fuel Research Committee was approved by the Council at its May 25 meeting.

ROBERT L. STANLEY has been awarded his Master of Science degree by Rutgers University where he has been graduate assistant in mechanical engineering.

RAYMOND LOEWY, industrial designer, whose most recent contribution in the automotive field is the body of the Studebaker Champion, has been awarded a $1000 prize offered by Lord & Taylor, New York, in the department store's annual competition to stimulate commercial designing.

K. W. WARREN, sales engineer, Federal-Mogul Corp., has been transferred from Chicago to the company's main office in Detroit.

A. E. FRUHWIRTH has been transferred from the Socony-Vacuum Oil Co., Cairo, Egypt, to the Vacuum Oil Co., A.G., Vienna, Germany.

CLINTON BRETTELL, newly appointed automotive engineer and service manager, Storch Leasing Corp., New York, recently addressed several groups of councilors in the division of Guidance Service maintained by the Board of Education of the City of New York, on "Possibilities in the Field of Automobile Mechanics." This cooperative effort on the part of the New York automotive industry is coordinated with the Board of Education and the Department of Vocational Education through the effort of **JOHN F. CREAMER,** chairman of the Advisory Commission on Automotive Education in the public schools. Mr. Creamer is president of Wheels, Inc.

DON. J. WALSH was elected the outstanding graduating senior engineer at the University of Oklahoma, where he is a member of the SAE Student Branch.

Reeves Resigns As AMA Manager

On the twenty-fifth anniversary of his election as general manager of the Automobile Manufacturers Association, **ALFRED REEVES** requested that he be relieved of his responsibilities as vice-president and manager of the Association, and the directors of the group acceded.

The AMA has not entirely lost the services of Mr. Reeves, as he remains on the board and assumes the newly created post of advisory vice-president. He also continues to manage the National Automobile Shows.

Pyke Johnson, who has been a vice-president of the AMA and in charge of its Washington office for many years, succeeds Mr. Reeves as general manager.

A pioneer in the automotive world, Mr. Reeves was the first automobile editor on a daily newspaper in the United States, serving on the *New York Daily Mail,* and later on the *Globe.* He raced automobiles on Daytona Beach and managed early races on New York tracks. In more direct contact with the industry, Mr. Reeves was a director of the American Motor Car Manufacturers Association and general manager of the United States Motor Co. prior to 1914, when he was elected to the post of general manager of the AMA, then the National Automobile Chamber of Commerce. During the World War he represented the automotive industry in Washington.

Alfred Reeves
(Underwood & Underwood photo)

JOSEPH GESCHELIN, Detroit technical editor, Chilton Publications, was luncheon speaker at the annual meeting of the department of standards and tests of the National Petroleum Association, in Detroit, June 22. His subject was "Tendencies in Engine Design with Respect to Fuels and Lubricants."

JOHN F. WINCHESTER, Standard Oil Co. of New Jersey, who recently retired as president of the New Jersey Motor Truck Association after serving five years in that capacity, was given a testimonial dinner by the Association in Newark, May 11.

W. R. Spiller
Chief Engineer

W. R. SPILLER, formerly special engineer, Timken-Detroit Axle Co., Detroit, has been appointed chief engineer, Seybold division, Harris-Seybold Potter Co., Dayton, Ohio. Before joining Timken-Detroit in 1938, Mr. Spiller was chief engineer of White Motor Co., with which he had been affiliated for 15 years.

MORRIS N. CRANDALL is with the Illinois Farm Supply Co., Chicago, in charge of water and truck transportation. Previously he was manager of the Wabash Valley Service Co., Grayville, Ill.

B. C. HEACOCK, president, Caterpillar Tractor Co., has been named to represent the SAE on the Division of Engineering and Industrial Research of the National Research Council. This division of the Council has been reorganized to provide for representation of the national engineering societies, the engineering section of the National Academy of Sciences, and members at large.

Recent changes at International Harvester advanced: **L. B. SPERRY,** from chief engineer, gas power engineering, to assistant to **A. W. SCARRATT,** vice-president in charge of engineering and patents; **D. B. BAKER,** from chief engineer, gas power engineering department, tractor works, to chief engineer, automotive engineering; **C. R. ROGERS,** from assistant chief engineer, gas power engineering, to chief engineer, gas power engineering, tractor works; **JOHN S. ERSKINE,** from engineer, allied industrial equipment, tractor works, to chief engineer, industrial engineering, tractor works. Mr. Erskine is SAE vice-president representing the Tractor & Industrial Power Equipment Activity.

B. B. BACHMAN broadcast over station WOR on the program entitled "Famous Firsts" on June 15. He described the first motor truck developed at the Autocar Co. Mr. Bachman is Autocar vice-president and chief engineer.

V. L. SMITHERS, of Akron, was appointed commissioner of the National Battery Manufacturers Association, Inc., at the annual spring convention of the association.

HERBERT CLARK is general manager of the Castle Bromwich Aeroplane Factory, Birmingham, England, and not deputy controller as was noted in the June SAE Journal.

R. L. CALEEN has joined the installation department of Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn. He previously was flight engineer with United Air Lines Transport Corp., Chicago.

News of the Society

Open Forum on Fleet Problems Winds Up Year

● **No. California**

"Information Please" might have been the title of the Northern California Section's final meeting of the year, May 9. S. B. Shaw was master of ceremonies, and with the help of several other Section members answered questions from the floor on problems of fleet operation. Those attending numbered 135.

"Should oil coolers be used?" asked one member. Chairman Shaw was relieved from answering this question by oil and bearing representatives who volunteered that the use of oil coolers, in certain types of operations, have resulted in longer bearing life, slower decomposition of oil, and have enabled the operator to use a lighter oil. "Maintain a moderately high jacket temperature, not less than 150 F, and keep the temperature of the oil going to the bearings within a range of 150-225 F, it was advised." Adverse comments indicated that breaks in the oil cooler connections would be expensive and that, since an oil cooler is a heat exchanger, it loses efficiency if not cleaned regularly.

The question, "What results have been obtained by plating wearing parts?" brought forward considerable testimony in regards to chromium plating cylinder liners, brake drums, clutch pressure plates, flywheels, and camshafts. In every case a large decrease in wear was reported. This was attributed to the fact that chromium has a high resistance to corrosion and that the plating gives the part a higher finish, making it less subject to scuffing. The chemical treatment of wearing surfaces to prevent scuffing was also discussed.

"Remove the cause," was the answer to the question as to what can be done to prevent batteries from running down. This difficulty was blamed upon low charging rates, heavy lubricants, defective electrical contacts, small cables, too small a battery, and other causes. One operator stated that he eliminated this trouble by installing voltage regulators which are set by instruments every 30 days.

Other questions extended the meeting far into the night. They involved such problems as fuels for diesel engines, with the opinion expressed that those available are satisfactory for transport service but are possibly not quite volatile enough for bus operations; the effect of increasing ring width in reducing cylinder wear; and relative merits of safety locks, cotter pins, and castle nuts.

Rapid Aircraft-Engine Development Predicted

● **Dayton**

Aircraft-engine development is to advance at an accelerated pace for the next five or ten years, but without radical changes in known types, said Arthur Nutt, vice-president of engineering, Wright Aeronautical Corp., in addressing the Dayton Section, May 22.

If America is to keep ahead of the world in aviation, more money must be poured into our research laboratories, Mr. Nutt declared, and he named three important developments that are needed in this country.

First, he said, we need a better spark plug; second, a more economical method of producing high-octane fuel; and third, a new system of specifying engine lubricants whereby the aircraft industry can obtain from the oil salesmen "a fluid which will really lubricate."

Mr. Nutt also urged more propaganda on American achievements in aviation today. Such a program, he said, would do much toward keeping John Q. Public interested in aviation – and his enthusiasm high in progress toward the Army and Navy goal of aerial supremacy.

Research Opportunities Myriad, Students Told

● **Detroit**

A student-junior activity meeting with all the technical flavor of a "grown-up" session closed the Detroit Section's regular activities for the year on May 16. Student paper prizes were awarded, the winning paper briefed by its author, and Dr. John J. Grebe, Dow Chemical Co., Midland, Mich., speaker of the evening, gave a dramatic presentation of his paper, "Adventures in Research," illustrating it with samples of new products and of materials still in the experimental stage, and by outlining some of the pressing problems which evade solution.

Consciousness of a spirit of adventure in research is not always present, even in the mind of the research man himself, Dr. Grebe conceded, but there are a myriad of possibilities for pure research in new and adventurous fields, he declared.

Dr. H. H. Dow, founder of Dow Chemical Co., was daring enough to attempt to remove the 0.13% of bromine from brine and in so doing revived and industrialized a section of Michigan where the previous industries, salt and lumber, had passed from the picture and left the area virtually destitute of activity, Dr. Grebe pointed out.

With brief but interesting excursions into such subjects as methods of obtaining bromine, insecticides and pharmaceutical compounds and magnesium metal from brine, coal, oil and sulfur; how to increase production of oil and gas wells; and how to produce the base of semi-plastic resin from oil, Dr. Grebe displayed two tables covered with new materials, several of which were fresh from the laboratory.

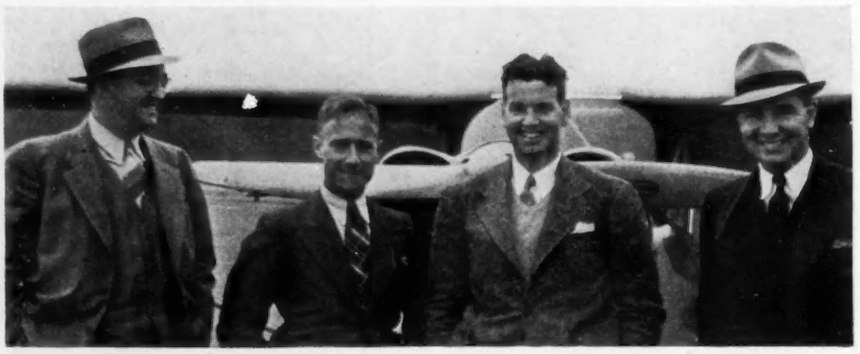
"We have just got tooled up for research," Dr. Grebe said, "and we must learn to use these research tools more and more effectively. Our efforts must double in effectiveness every four years. The average increase must be about 20% a year, compared with an increase of efficiency of farms and industry of about 3% per year."

Dr. Grebe outlined the following five problems with which the young engineer advantageously might concern himself: (1) automatic steering of automobiles and airplanes through an electrical device and conductors along highways or air routes; (2) the perfection of radio facsimile transmission synchronized with audio transmission on the same wave band by utilizing the wave band more effectively, modulating frequency as well as amplitude; (3) invention of a "dummy" thinking apparatus for use with shock absorbers to provide ride control according to requirements of each individual shock instead of controlling only in a general way according to deflection, rate, or position; (4) the use of styrene (one of the new plastics shown by Dr. Grebe) combined with hemp or steel to make fenders and other automotive parts; and (5) perfection and more general application of the fluid flywheel or torque converter.

Digests Prize Paper

Prizes in the Detroit Section Student Paper Contest were awarded at this meeting. Of ten papers submitted by Michigan technical schools, four were adjudged worthy of particular mention. The paper, "Front Wheel Suspension," by La Verne B. Ragsdale of Lawrence Institute of Technology, Highland Park, Mich., won for him the first prize of $50, which was awarded at the

SAE Members Organize Flying Club



These four members of the Northern California Section recently formed a flying club and purchased the airplane seen in the background

They are, left to right, R. W. GOODALE, Section field editor and publicity chairman; Dr. A. G. CATTANEO; W. V. HANLEY, member of the aviation committee; and E. J. McLAUGHLIN. Dr. Cattaneo is with the Shell Development Co., and the other three men are with Standard Oil Co. of Calif.

meeting. Mr. Ragsdale, who is employed in the Packard Motor Car Co. aircraft engine division, gave a brief résumé of his paper with slides and won applause for the professional manner in which the paper was prepared and presented. He not only criticized present front-end suspension methods, but offered for consideration a new design utilizing the longitudinal system of parallelogram links which he referred to as the "caster type."

"Attempts have been made to approach the results of the 'caster type,' but owing to manufacturing difficulties in making the coil spring stand up under such high stresses there have been failures along this line," Mr. Ragsdale declared. The reason for using leaf springs in the described design, he said, is because this type of spring is giving satisfactory results in the present rigid axle models and adds strength to the structure. Excessive tire wear on independently sprung front wheels is a cause for great concern since it affects the public directly, he continued. "Owners were aware of the fact that the front tires on rigid axle cars wore about twice as long as tires on the rear, but with the independents of today this is not true," he said, "since tests have shown the front and rear tires to wear about even. This is an added expense the public should be spared and it can be done, provided the proper method is used in suspension. The causes for this excessive wear have been pretty well determined as (1) tread or track change; (2) camber change; and (3) steering misalignment on turns."

Dealing with each of these aspects and with gyroscopic reaction and steering requirements, Mr. Ragsdale suggested a suspension system with a steering spindle mounted on a vertical support to carry the rotating end of two trailing arms of equal length which form a parallelogram longitudinal to the car frame. The system includes necessary shock absorbers and a torsion bar. One of the important details is the use of leaf springs with shackles at each end of the spring. Provision for either Pitman-arm or center arm steering is made. Mr. Ragsdale claimed that the design offers a true parallel motion of road wheels on both jounce and rebound and that each wheel moves independently from the other. Therefore, he stated, there is no tire scuff as is experienced in other designs. In addition he claims that ample room is provided in this type of layout to move the engine forward from 8 to 12 in.

Other Winners Named

Second prize winner was Bernard Maurer, Michigan State College, East Lansing, who described an "Automatic Unit Injection Pump." He was awarded a $25 prize.

Third and fourth prizes, which were one-year free student memberships in the SAE, were given to Jack Probst of the University of Michigan and to Fred Monahan of the Detroit Institute of Technology. Their papers dealt with "Operating Economy and Weight Reduction," and "Considerations of Safety, Comfort, Appearance and Economy," respectively.

Field Experience Said Essential to Engineers

● **Oregon State**

Field experience is essential for good factory production and engineering work, members of the Oregon State College Student Branch were told by Kenneth A. Ayers, Standard Oil Co. of Calif., at their May 11 meeting. In his talk, "The Position of the Service Engineer in the Automotive Industries," Mr. Ayers told the students what they may expect when they go into the field after graduation. The speaker was introduced by Chairman Harold Ager.

The following officers were elected for the next year at the May 15 meeting of the Student Branch: Victor Mills, chairman; R. Jack Brun, vice-chairman; and Clifford Parmley, secretary-treasurer.

'Rocket Motor' Subject Of Prize Winning Paper

● **Milwaukee**

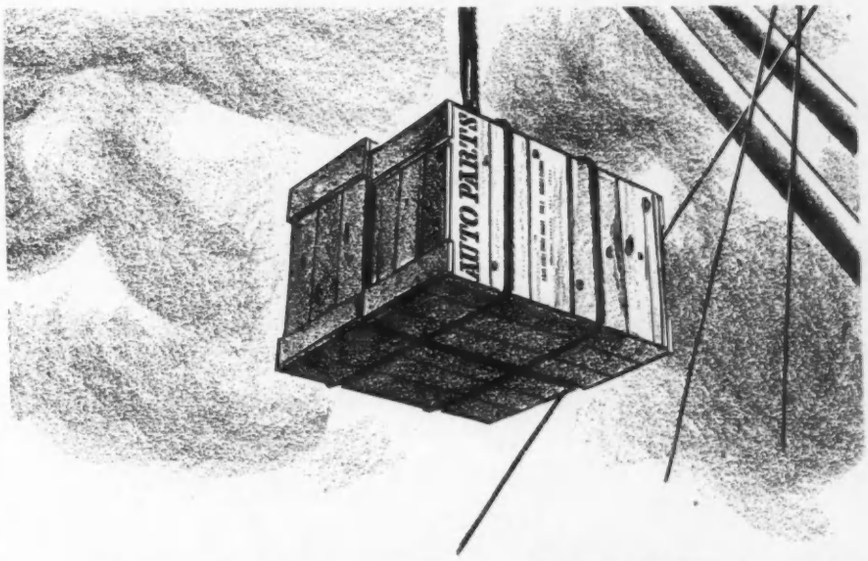
"The Amazing Possibilities of the Rocket Motor," a paper by Robert E. Wright, a member of the SAE Student Branch at the University of Wisconsin, was digested at the Milwaukee Section's Ladies' Night meeting, June 9. Judged the best paper submitted in the Section's student paper contest, its author was awarded the first prize of $20 credit with the Society for junior membership initiation fee and one year's dues.

The affair was a dinner and dance with a short program of interesting features. Retiring officers of the Student Branch were present as guests of the Section.

Dinner Honors SIA Delegates in Detroit

Amity existing between France and the United States was stressed by SAE President William J. Davidson, presiding at a dinner in Detroit, May 18, honoring 13 delegates representing the Societe des Ingenieurs de l'Automobile, France, at the SAE World Automotive Engineering Congress. SAE officers in the Detroit region and Detroit members of the SIA participated.

Mr. Davidson greeted the visitors in their own language and recalled some of his War experi-



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ences in France. Welcome from the Detroit Section was voiced by its chairman, R. N. Janeway. Col. J. G. Vincent, president of the Society in 1920, spoke of the excellent cooperation he received from French aviation experts in the design of the Liberty engine.

On behalf of his colleagues Henri Petit, president of the SIA, expressed their sincere appreciation for the cordial reception. Mr. Petit also drew attention to the historical background supporting the claims of Beau de Rochas to the invention of what is now called the Otto cycle. He gave everyone present a copy of the plaque dedicated at the New York World's Fair in commemoration of de Rochas' contribution to industrial progress.

Before the dinner Col. Vincent entertained the foreign guests at a cocktail party.

The SIA delegates visited the automobile plants in Detroit prior to the opening of the Congress in New York, May 22.

Committee on Rubber Products Gets Under Way

At the initial meeting of the recently organized Technical Committee on Standardization of Rubber Products, functioning under Committee D-11 of the American Society for Testing Materials, it was reported that substantial progress is being made towards completion of a program that will be of great importance to the rubber as well as the automotive industry.

The committee's first study, it was decided, will be limited to rubber engine mounts. One subcommittee of rubber representatives will study present material specifications for this item, and a second subcommittee, of automotive representatives, will review available methods of testing.

The findings of these two subcommittees will be considered at the next meeting of the full committee, scheduled to take place this month.

L. A. Danse was elected chairman of the committee and J. D. Morron, secretary.

SAE representatives are: W. H. Graves, representing Packard Motor Car Co.; J. M. Crawford and C. E. Zwahl, alternate, representing Chevrolet Division of General Motors Corp.; L. A. Danse and H. C. Mougey, alternate, representing Cadillac Motor Car Division of GMC; W. S. James and W. J. Harris, alternate, representing Studebaker Corp.; H. E. Simi, representing Twin Coach Co.; A. G. Herreshoff and W. J. McCortney, alternate, representing Chrysler Corp.; H. M. Northrup and J. G. Gagnon, alternate, representing Hudson Motor Car Co.; and L. S. Sheldrick and Dr. Laird, alternate, representing Ford Motor Co.

Representatives of 10 rubber companies have been appointed by the ASTM. Other members, to be named, will represent heavy vehicle manufacturers, the aircraft industry, and the United States Army and Navy Departments.

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Students Hear Bower On Hesselman Engine

● **U. of Wisconsin**

Important points of construction and operation of the Hesselman oil engine were explained to members of the Student Branch at the University of Wisconsin at their May 25 meeting, by L. L. Bower of the Waukesha Motor Co.

It was shown by Mr. Bower that because of the low injection pressure of this type of engine, the life of the fuel pump is longer than for pumps of most other engines using oil for fuel. He emphasized that the light construction of the engine renders it usable in places where gasoline engines are now being used, and that its operating costs are lower.

He described the engine as being of the over-head valve type with the entire combustion space in the cup-like hollowed top of the piston. The fuel is injected into this space tangentially so that a swirl is developed in the cup, resulting in more complete combustion, he explained. It was also noted that the spark plugs have long shanks so that they will fit well into the chamber opposite the fuel injector. In this engine, he added, no excess air is allowed into the cylinders.

The surprise of the evening came when Mr. Bower exhibited the 2-cyl air-cooled Waukesha gasoline engine that is being installed in the new Crosley car. This engine, he said, will drive the car up to 50 mph with a gasoline consumption of about 50 to 60 mpg.

Officers elected for the coming year are: Kenneth Pike, chairman; Fred Leidel, vice-chairman; Bert Clark, secretary-treasurer; Charles Borcher, field editor, and Prof. G. C. Wilson, honorary chairman.

SAE Joins in Safety Glass Research Study

The SAE, which is one of the major interests represented on the Sectional Committee on Specifications and Methods of Test for Safety Glass, under procedure of the American Standards Association, has accepted appointment to a special subcommittee recently organized. This subcommittee will study the following recommendations and others that may arise, and develop the necessary research program needed to produce adequate information about each:

1. Determine the imprisonment hazard with the various kinds of safety glass.

2. Determine flying glass hazard with different types of safety glass.
3. Determine change in characteristics of glass due to variations in weather conditions.

George L. McCain, Chrysler Corp., will represent the Society on the subcommittee.

It is proposed that in addition to the SAE the following organizations will be represented: American Association of Motor Vehicle Administrators, American Transit Association, Safety Glass Association, and the sponsors of the code, namely, the National Bureau of Standards and the National Conservation Bureau.

Plenty Left to Do, Sibley Tells Students

● Tulsa Group
● U. of Oklahoma

Automotive and lubricating engineers up to now have just scratched the surface, and 1939 graduates should not be misled into believing that there is nothing left for them to do, B. E. Sibley, Continental Oil Co., told SAE Student Branch members at the University of Oklahoma on May 10, when the Branch was host to the Tulsa Group. Silas Gassett, retiring Student Branch chairman, who presided, was introduced by T. J. Schuetz, president of the Braden Winch Co. Sessions were held in the afternoon and evening, separated by a tour of the University's engineering laboratories and a dinner served in the Student Union building.

Mr. Sibley, who covered general problems involved in the development of lubricants to satisfy modern automotive equipment requirements, shared the afternoon program with Ottie Eads, engineering student at the University, who spoke on "Comparative Tests in the Use of Propane, Butane, and Acetylene Gas in Cutting Steel."

Tests to date, Mr. Eads said, indicate that with propane and butane there is a slightly higher oxygen cost per linear foot, especially on materials as heavy as ¾, 1, and 1¼-in. stock, when compared with oxygen-acetylene cutting. However, he said, the cuts obtained are greatly superior in appearance to the acetylene cuts, being almost entirely free from "slag" typical of the lower edge of material when acetylene is used.

Harry Kramp, sales engineer, Fred E. Cooper Co., Tulsa, took "Portable Well-Servicing Equipment" as his topic before the evening session. He touched upon the history of well servicing, development of portable equipment, special uses of these units, and problems encountered in the field.

The SAE Student Branch exhibit during the University of Oklahoma's Engineers' Open House, was a "parade of progress" in automotive transportation. On display were 19 passenger cars of vintages ranging from 1909 to 1939, and a cutaway working model of an International Harvester diesel engine.

Elected to hold Student Branch offices next year are: Merle W. Lucas, chairman; N. A. Tinker, Jr., vice-chairman, and Leon E. Loudermilk, secretary-treasurer.

SAE Cooperates With ICC Safety Section

The SAE has been asked by the Safety Section of the Interstate Commerce Commission to cooperate on engineering problems involved in studies which it is inaugurating with view of drafting safety regulations affecting, among other things, fuel tanks, wiring, brakes, coupling devices, tires, and lighting equipment.

This request was made to the Society's Engineering Relations Committee, and upon its recommendation was approved by the Council at its meeting of May 25.

Name Representatives On Aircraft Committee

Appointments of SAE representatives on the ASA Sectional Committee on Standardization in the Aeronautical Field were approved by the Council at its May 25 meeting.

Representing the aircraft manufacturers are T. P. Wright, Curtiss-Wright Corp., and J. F. Hardecker, Naval Aircraft Factory, with J. T. Thompson, Glenn L. Martin Co., as alternate.

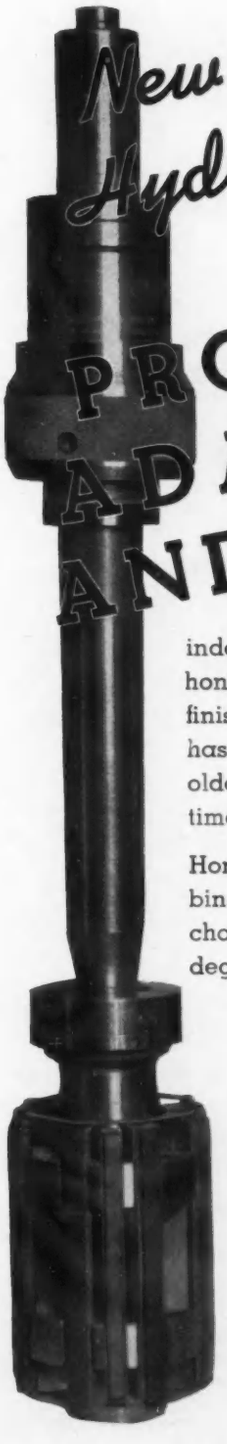
Aircraft engine manufacturers will be represented by Arthur Nutt, Wright Aeronautical Corp., and C. H. Chatfield, United Aircraft Corp., with A. T. Gregory, Ranger Engineering Corp., as alternate.

J. R. Cautley, Bendix Aviation Corp., and C. H. Colvin, Kollsman Instrument Co., are representative and alternate, respectively, for accessory manufacturers.

Representing the aircraft fuels division of the petroleum industry is T. B. Rendel, Shell Oil Co., Inc., with D. P. Barnard, Standard Oil Co. (Indiana), as alternate.

Section Inspects Steel Plant

On the afternoon of May 18 some 160 members and guests of the Pittsburgh Section made a tour of the Irvin Works of the Carnegie-Illinois Steel Corp. This was followed by a dinner at Bill Green's and a session at which one of the steel company engineers answered questions stimulated by the tour.



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SAE Members Invited to International Forum

Members of the SAE have been invited to participate in the joint meeting of The Institution of Civil Engineers (England), The Institution of Mechanical Engineers (England), and the Engineering Institute of Canada, with the American Society of Civil Engineers and the American Society of Mechanical Engineers, in New York, Sept. 4-8. President Davidson has accepted an invitation to take part in several important functions.

The civil engineers and the mechanical engineers will hold a joint opening session, banquet, and closing session. Technical sessions of the civil engineering group will be held at Columbia University, and of the mechanical engineers, at the Engineering Societies Building.

The program of the mechanical engineering societies will include papers on marine transport, light-weight high-speed trains, highway transportation, and transatlantic airplanes.

Truck Rating Report Gets Council Approval

The SAE Motor Truck Rating Committee has completed its recommendations on "The Ability Rating of Motor Trucks in Relation to Engineering Aspects of Minimum Performance Requirements," which were developed by the Society at the request of the Automobile Manufacturers Association.

The recommendations have been approved by the SAE Council and transmitted to the AMA.

'Auto Headlighting' Prize Paper Subject

● **Cleveland**

His paper on "Automotive Headlighting" won a $50 scholarship for Walter E. Moore, a student at Case School of Applied Science, in the student paper contest sponsored by the Cleveland Section. The presentation was made at the Case commencement exercises held during the last week of May.

Honorable Mention was given to Verne Pulsifer, for his paper, "Bearings"; to C. F. Ruebensaal, for his paper, "Better Finishes for the Automotive Industry through Electrochemistry"; to Covert W. Howard, for his paper, "Air Conditioning of Passenger Cars"; and to Henry Schmidt, for his paper, "The Radio Compass."

This is the second year that the Cleveland Section through its Student Activity Committee, headed by Hoy Stevens has sponsored a contest for students enrolled in technical composition courses at Case. Regular term papers are entered in the contest.

Change in Status

The SAE has relinquished active administration of the Sectional Committee on Wire and Sheet Metal Gages which functions under the procedure of the American Standards Association, but has retained co-sponsorship of the project.

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About Authors

(*Concluded from page* 11)

has given him a variety of experience on experimental development and testing of aircraft engines. For the last four years his duties have dealt primarily with vibration problems associated with aircraft engines. In 1936 he was appointed assistant senior engineer of the laboratory. A graduate from the University of Pennsylvania with the class of '28, he received his Master's degree from the same institution in 1932.

● **Frank C. Mock** ***(M '11) first entered automobile engineering with the F. B. Stearns Co. in Cleveland in 1903. Later he was engineer with Royal Tourist, Stoddard-Dayton, Jeffery and other automobile manufacturers. In 1912 he joined Stromberg Motor Devices Co. and was transferred to the engine division of Bendix Research Corp. in 1929. In 1935 he became vice-president of Carburetor Engineering for Bendix Products Corp. and moved his headquarters to South Bend.***

● **Ernest E. Wilson** ***(M '37) has been with the General Motors Corp. since 1928. Prior to 1936 he was with the Research Laboratories, and at that time was transferred to the GM proving ground to take charge of the sound laboratory. He is now technical assistant to the director of the proving ground. Prior to his affiliation with General Motors, he spent two years at the NACA laboratories at Langley Field, Va. His first serious contact with automotive products was during the World War and had to do with Signal Corps trucks. After the War he had a variety of experience in the automobile and tractor field. His college training was sandwiched in at intervals during the period after the War, with attendance at the University of Wisconsin and the Iowa State Teachers College.***

Obituaries

Percival S. Tice

Percival S. Tice, a member of the Society since 1908, died May 19. Since 1933 Mr. Tice had practiced as engineering and patent consultant in Chicago, following 15 years' association with the Stewart-Warner Corp., where he was long director of the carburetor division.

Mr. Tice had been affiliated with the automotive industry since 1902, when he joined the Ford Motor Co. which was then building its first 2-cyl. cars. He later was employed by the Reliance Motor Car Co., St. Louis Motor Car Co., and Holley Brothers. He also spent several years on the editorial staffs of *The Horseless Age* and *Motor*.

Born in Detroit in 1881, Mr. Tice attended the Detroit High School and extended his education while gaining practical experience in the industry.

Rolf L. Olsen

Rolf Olsen, partner in the firm of Todd & Olsen, Bronxville, N. Y., died at his home in New Rochelle, May 24. He had been ill for six weeks.

A native of Norway, Mr. Olsen came to this country in 1914 as designer for the Caille Perfection Motor Co. of Detroit. He had earlier graduated from the Christiania (Norway) University of Engineering, and had worked in England developing and testing cycle cars, aeroplane engines and diesel engines. Before entering partnership with R. W. Todd in 1922, Mr. Olsen had been employed as designer by Loew Victor Motor Co., Sterling Engine Co., Curtiss Aeroplane Co., and Fergus Motors of America.

Mr. Olsen was born in Horten, Norway, in 1891, became a citizen of the United States in 1919, and a member of the SAE in 1920.

Grover Ira Mitchell

Grover Ira Mitchell, professor of mechanical engineering, Grove City College, Grove City, Pa., died May 28 following an automobile accident. He was 50 years old.

Prof. Mitchell, who had been a member of the SAE since 1921, graduated in mechanical engineering from the University of Illinois in 1915. While attending college he had a part time position with the Streator Motor Car Co., makers of Halliday automobiles.

After graduating he was with the American Bureau of Engineering for one year before accepting his first teaching post with the Louisiana Industrial Institute. He later was affiliated with the University of Pittsburgh, University of Wisconsin, Iowa State College, Pennsylvania State College, and, after 1932, with the Grove City College.

Prof. Mitchell was the author of several text books on automobile maintenance and a number of articles appearing in trade publications.

Col. Charles de Forest Chandler

Col. Charles de Forest Chandler, U.S.A. (retired), chief of the balloon section of the Army Air Service in France during the World War, died May 17, at the age of 60. He had been a member of the SAE since 1928.

Col. Chandler, who retired from the Army Air Service in 1920 after a military career that began in 1898, was a pioneer in the development of the military air service of this country. He was the first head of the Aeronautical Division of the Signal Corps, formed in 1907, and in 1911 he was placed in command of an experimental Army air school in College Park, Md.

Col. Chandler served in the Spanish-American War, the Philippine insurrection, the Mexican expedition, and the World War, and was awarded the Distinguished Service Medal.

After his retirement, Col. Chandler devoted himself to writing, and became aeronautic editor of the Ronald Press Co. in 1925. He published two books of which he was co-author, "Free and Captive Balloons" and "Balloon and Airship Gases."

T. Morey Rude

T. Morey Rude, vice-president and general manager of the Bundy Tubing Co., Detroit, died May 27. He was 54 years old.

Mr. Rude, who became an associate member of the Society in 1925, had been affiliated with the Bundy company since 1923, assuming the position of vice-president in 1936. He had earlier been associated with the J. C. Haarty Co., Fiat, Scripps Booth, Rands Mfg. Co., Metal Products Co., and Weston Mott Co.

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New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between May 15, 1939, and June 15, 1939.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section

RAPPLEYEA, GEO. W. (A) consulting engineer, 2514 Harford Road, Baltimore.

Canadian Section

GILMOUR, JOHN P. (A) Ontario manager, Collins & Aikman of Can., Ltd., Farnham, Que., Can. (mail) Room 1212, 55 York St., Toronto, Ont.

JONES, FREDERICK G. (A) auto parts salesman, Bennett & Elliott, Ltd., 1108 Bay St., Toronto, Ont. (mail) 103 Old Orchard Grove.

Chicago Section

PAINE, WILLIAM B. (M) chief engineer, B-K Vacuum Power Div., Bendix Products Division, Bendix Aviation Corp., 401 Bendix Drive, South Bend, Ind.

SIROTEK, HENRY B. (J) manager, Diesel Service Dept., Illinois Auto Electric Co., 2101 Indiana Ave., Chicago.

SMITH, JOHN (A) superintendent of maintenance, Pennoyer Merchant Transfer Co., 742 W. Polk St., Chicago.

Cleveland Section

HANSMAN, GEORGE A. (A) sales engineer, assistant to general manager, Speed Nut Division, Tinnerman Stove & Range Co., 2038-2048 Fulton Rd., Cleveland.

MORIARTY, WILSON H. (M) sales engineer, National Malleable & Steel Castings Co., 10600 Quincy Ave., Cleveland.

POND, BENHAM S. (M) transmission project engineer, The Acrotorque Co., Box 5613, Cleveland.

ROCHE, PAUL C. (J) sales engineer, Mechanical Rubber Division, Firestone Tire & Rubber Co., Akron, O.

Dayton Section

BROWN, W. RAY (SM) principal engine draftsman, U. S. Army Air Corps, Wright Field, Dayton (mail) 1601 Salem Ave.

DETTMER, AIBERT B. (A) assistant to president, K-D Lamp Co., 610-616 W. Court St., Cincinnati, O.

Detroit Section

BAER, SIMON (M) designing engineer, Baer Engineering Co., Detroit (mail) 60 Rhode Island Ave.

BESSMER, DWIGHT A. (M) sales engineer, Timken Roller Bearing Co., Canton, O. (mail) 1111 Fisher Bldg., Detroit.

CORBET, H. G. (A) motor division engineer, Hyatt Bearings Division, General Motors Corp., 8-166 General Motors Bldg., Detroit.

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Kansas City Section

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Metropolitan Section

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MILLER, JAMES K. (A) assistant manager, Wagner Electric Corp., 41 W. 65th St., New York.

MURRAY, MAX DAVIS (J) experimental tester, Wright Aeronautical Corp., Paterson, N. J. (mail) 930 E. 26th St.

PARKSTON, GEORGE ALFRED (A) salesman, Delco Frigidaire Conditioning Div., General Motors Sales Corp., 375 Flatbush Ave. Extension, Brooklyn, N. Y. (mail) 1464 Ocean Ave.

SAWERS, WILLIAM B. (M) manager, New York Office, Koppers Co., American Hammered Piston Ring Division, 15 Moore St., New York.

SCHULZ, JOHN C. (M) treasurer, manager, Syosset, L. I., N. Y.

VARRICCHIO, FREDERICK O. (A) foreman, Hudson Laundry, 532 W. 19th St., New York (mail) 1350 Bergen St., Brooklyn, N. Y.

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LEYSIEFFER, WALTER (A) service engineer, Harnischfeger Corp., Milwaukee (mail) 3056 N. Cambridge Ave.

Northern California Section

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CONROY, RAYMOND WILLIAM (A) manufacturers' agent, sole owner, 632 Polk St., San Francisco.

MADIGAN, CLAUDE EDWARD (A) inspector, Pacific Gas & Electric Co., 245 Market St., San Francisco (mail) 75 Naples St.

Philadelphia Section

DRINKER, HENRY S., III (J) engineer, SKF Industries, Inc., Front St. & Erie Ave., Philadelphia (mail) 249 Merion Rd., Merion, Pa.

MOODY, LEWIS F., JR. (J) mechanical engineer, auto laboratory, Socony-Vacuum Oil Co., Research & Development Division, Paulsboro, N. J.

WELLER, PERRY ROBERT (A) supervising principal, Jourden Technical School, Inc., 3113 N. Broad St., Philadelphia.

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St. Louis Section

GARNER, JAMES EARL (A) superintendent, transportation equipment, Union Electric Co. of Mo., St. Louis County Gas Co., St. Louis (mail) 6451 Page Blvd.

STETSON, GEORGE L. (M) engineer, research, Shell Oil Co., Inc., Shell Bldg., St. Louis.

Washington Section

LOCKWOOD, W. S. (A) director, Crude Rubber Develop. Bureau, 820 Munsey Bldg., Washington, D. C.

OSBORN, EARL PINE (SM) air safety investigator, Air Safety Board, Civil Aeronautics Authority, Washington, D. C. (mail) 1206 N. Harrison St., Arlington, Va.

SHAVER, F. D. (A) director of service, L. P. Steuart, Inc., 1440 P St., N.W., Washington, D. C.

Outside of Section Territory

CHRISTIAN, A. E. (A) service manager, Breen Motor Co., Ltd., Norwood, Man., Can. (mail) 213 Claremont Ave.

COUGHLIN, RICHARD JAMES (A) president, Westland Oil Co., Minot, North Dakota.

CRISOSTOMO, VICENTE D., 2nd Lieut. (J) Philippine Army, Motor Transportation Headquarters & Service Co., Port Area, Manila, P. I.

DONLEY, CARSON O. (J) tool designer, Clark Equipment Co., 404 W. Front St., Buchanan, Mich.

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(*Concluded from page 54*)

GRAFFLIN, CHARLES FREDERICK (A) manager, Beach Boat Slips Corp., 1928 Purdy Ave., Miami Beach, Fla.

HEACOCK, B. C. (A) president, Caterpillar Tractor Co., Peoria, Ill.

JEFFERSON, MONCRIEF O. (M) chief engineer, Albany Div., Socony-Vacuum Oil Co., Inc., 112 State St., Albany, N. Y.

KLOTZ, J. CHARLES (M) instructor, Department of Mechanical Engineering, College of Engineering, University of Tulsa, Tulsa, Okla.

KROHNE, CARL A. (J) proprietor, Krohne's Automotive Service, 151 Federal St., Greenfield, Mass.

SANBORN, JOHN B. (M) executive engineer, Pratt & Whitney Aircraft, Division of United Aircraft Corp., East Hartford, Conn.

SARGENT, LENNOX L. (J) president, Southwest Boat Corp., Clarke Point Rd., Southwest Harbor, Maine.

WHITMORE, HARVEY E. (A) chief mechanic, U. S. Bureau of Public Roads, 915 S. Logan St., Denver, Colo.

Foreign

BLANC, JACQUES (FM) chief engineer, Societe des Moteurs Gnome et Rhone, 70 Blvd. Kellermann, Paris (13°), France.

DONCASTER, BASIL WILSON (A) director, Daniel Doncaster & Sons, Ltd., 284 Penistone Rd., Sheffield 6, England.

FOSTER, DAVID BLYTHE (FM) power unit research engineer, Vauxhall Motors, Luton, Bedfordshire, England.

JUDSON, CHARLES ALLAN (FM) designer, Rolls-Royce, Ltd., Derby, England.

SICKINGER, HANS (A) owner, Mecano, G.M.B.H., Bockenheimer Anlage 48, Frankfurt A/M, Germany.

TATTON, AVON CECIL (A) proprietor, Tatton Bros. Rangatira Service Sta., Queen St., Masterton, New Zealand.

THOMAS, WILLIAM M. W. (FM) managing director, Wolseley Motors, Ltd., Ward End, Birmingham, England.

WORTH, THOMAS CLAUD (FM) director, general manager, British Filters, Ltd.; Harborough Aircraft Construction Co., Ltd., Market Harborough, England (mail) Sutton Basset.

Applications Received

The applications for membership received between May 15, 1939, and June 15, 1939, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

SCHELL, FRED H., sales promotion manager, Black & Decker Mfg. Co., Towson, Md.

WISE, WILLIAM H., assistant standards engineer, The Glenn L. Martin Co., Middle River, Md.

Canadian Section

COLEMAN, CARROLL WILLIAM, purchasing agent, Gotfredson, Ltd., Windsor, Ont., Canada.

RICE, HARRY ALBERT, Rogers Automotive Parts, Toronto, Ont., Canada.

VAUGHAN, JOHN A., service manager, Northern Auto Co., Kirkland, Ont., Canada.

Chicago Section

BUCKLEY, EDWARD T., manager, Trucking Department, The Cudahy Packing Co., Chicago.

OLSEN, OSCAR L., service engineer, Electro-Motive Corp., La Grange, Ill.

STIMSON, JONATHAN CASS, Stimson Reflector Co., Chicago.

Cleveland Section

MADOLE, GEORGE M., assistant to manager, manufacturers sales, B. F. Goodrich Co., Akron, O.

PETTERSON, CLARENCE O., district sales manager, Fulton Sylphon Co., Cleveland.

Dayton Section

HASWELL, ANTHONY, vice-president, Dayton Malleable Iron Co., Dayton.

STANDISH, SHERWOOD H., general manager, G H R Foundry Co., Dayton.

STOCKUM, ERNEST JOHN, G H R Foundry Co., Dayton.

Detroit Section

AMNOTTE, GILBERT C., engineering draftsman, Packard Motor Car Co., Detroit.

BLOOMER, W. L., manager, lubrication department, Hickok Oil Co., Toledo, Ohio.

BOWMAN, LEO P., inspection foreman, Chrysler Corp., Detroit.

FLEMING, A. M., general works manager, Chrysler Corp., Detroit.

MITCHELL, CLYDE H., division manager, Gates Rubber Co., Detroit.

OSBORN, WILLIAM C., superintendent, trim division, Murray Corp. of America, Detroit.

VILLAIRE, JOSEPH W., assistant chief inspector, Chrysler Corp., Detroit.

Metropolitan Section

BERG, HAROLD R., division manager, Ethyl Gasoline Corp., New York.

KARTVELI, ALEXANDER, vice-president in charge of engineering, Seversky Aircraft Corp., Farmingdale, L. I., New York.

Milwaukee Section

PORTZ, CHARLES A., owner, Fleet Service Specialties Co., Milwaukee, Wis.

New England Section

GARDNER, ROBERT, manager, automotive department, Lever Bros. Co., Cambridge, Mass.

LESTER, WILLIAM M., general manager, Commonwealth Plastic Co., Leominster, Mass.

WILLSHIRE, FREDERICK, vice-president, Auto Ignition & Parts Co., Camden, N. J.

Southern California Section

HITE, WALTER ALLEN, project engineer, Vultee Aircraft, Downey, Calif.

MILLAR, RICHARD W., vice-president and general manager, Vultee Aircraft, Division of Aviation Manufacturing Corp., Downey, Calif.

WINTRINGHAM, JOHN S., research engineer, Ethyl Gasoline Corp., San Bernardino, Calif.

Southern New England

EMERSON, DAVID, inspector, Pratt & Whitney Aircraft, E. Hartford, Conn.

Outside of Section Territory

WHITE, DONALD, general manager, The Toobflim Co., Memphis, Tenn.

Foreign

EVANS, WILLIAM, works manager and director, Motor Components (Birmingham) Ltd., Birmingham, England.

MURPHY, EDWARD WILLIAM, engineer, Transportes Aereos Centro-Americanos, Tegucigalpa, Honduras, C. A.

SIRTORI, ALESSANDRO, chief engineer, Alfa Romeo, via M. U. Traiano, Milano, Italy.

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